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One Hundred and Twenty-inch Planer.

We present on this page an engraving of a planer, which planes work 10 feet 2″ square, and may be made with any length of bed desired. The driving mechanism is usually so arranged that the planer stands parallel to the line shafting.

A distinctive feature of the design is in the fact that the central portion of the bed to which the housings are attached, and within which the bearings for the driving shafts are located, and which thus takes the full strain of the cut, is made deeper than those portions at either end which do not bear this strain, the depth at either end being 27¾″, and in the center 36½″.

The posts are 20″ wide on the face, and each carries an extra head, which has a bearing 20″ long on the post, is counterbalanced, and has automatic feed varying from $\frac{1}{32}$″ to $\frac{9}{64}$″. The saddles on the cross-rail have a horizontal feed varying from $\frac{1}{16}$″ to 1″, and the vertical feeds of these heads are just half the above rates.

Feed motion is derived from the vertical splined shaft shown, which is rotated back and forth by a positive feeding device which is frictionless when not feeding. This shaft moves the slotted lever from which the sector is driven as shown, this lever being slotted both sides of the center upon which it oscillates, so that the feed may be made to take place at either end of the stroke.

From this splined shaft also is derived motion for a shaft which passes through the cross rail, and by means of a cam operates to lift and hold up the tool during the return of the platen.

Cross-rail, like the housings, is of the box form, and is 30″ deep vertically, and 22″ horizontally, its length being sufficient so that either of the heads upon it may be fed over the entire space between the housings.

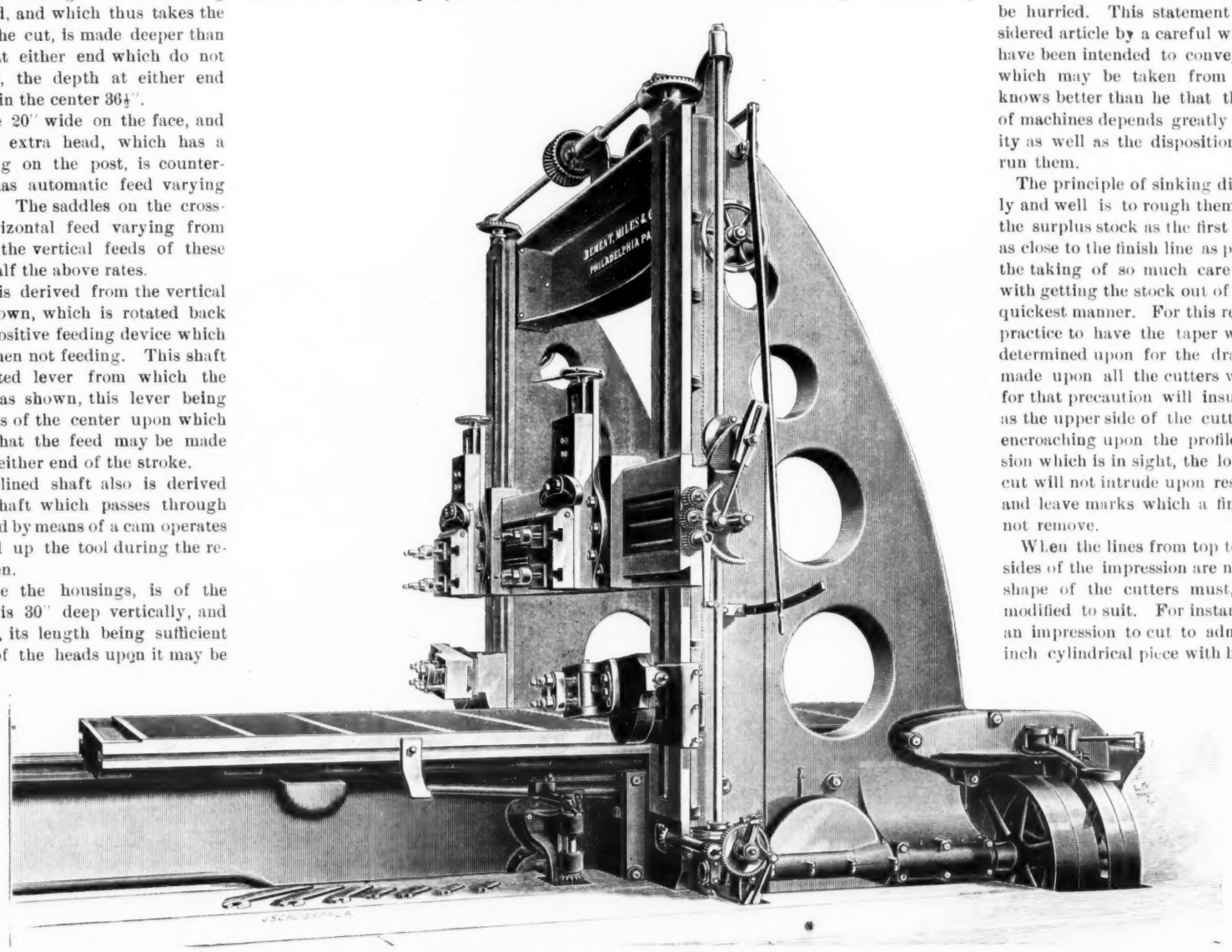
The usual arrangement of the clapper boxes is reversed, the swinging portion to which the tool is attached being fitted over the other part instead of inside it, thus securing the full width of the slide for a space within which to fasten and hold tools, the T slots extending entirely across the face of the clapper, and thus enabling the tool to be placed in the most advantageous position for the work in hand.

Cross-rail is raised and lowered by power, and this is so arranged that it cannot be operated except when the planer is otherwise at rest, thus reducing the risk of an accident with it.

Arranged as shown, the pulley shaft transmits its motion to the second shaft by means of a phosphor bronze bevel pinion, and the bearings of this first shaft are bushed with plain sleeves of brass, which may be readily replaced when worn. The belts are shifted one at a time, may be shifted by hand from either side of the machine, and may also be so shifted by hand as to bring the platen to rest at any point while the belts continue to run. Recognizing the advantages of fast running and relatively narrow belts for machines of this character, the belt ratio has been made as high as it is thought practicable to go with it without introducing an objectionable amount of momentum to be taken up and overcome at each end of the stroke.

The platen is very deep, to give great stiffness, and is driven by a rack and bull wheel of 15″ face, 2½″ pitch. The return motion of the platen is 60 feet per minute. Special automatic devices are employed for oiling the ways.

Though the sizes mentioned above are true of this particular planer which we illustrate, a planer of this size is not considered an article of manufacture in the sense in which a smaller machine is so considered, but is usually built to order, and for some specified kind of work, the machine being then constructed especially for that work, and proportions varied to suit it, so that the figures given should not be considered as those of the builder's 120″ planer, but rather of this particular machine. It is made by Bement, Miles & Co., Philadelphia, Pa.



ONE HUNDRED AND TWENTY-INCH PLANER.

The average distance traveled by each railroad passenger in Russia is nearly three times as great as in the United States.

Die-sinking.

By B. F. SPALDING.

USING THE DIE SINKING MACHINE.

The same general directions for preparing drop dies and laying out the impressions which are to be cut in them, that were given in the article on die-sinking which appeared in the AMERICAN MACHINIST, September 15, 1892, are applicable to dies which are to be cut with all the advantages of machinery as well as those which are to be cut with simpler tools in the manner therein described except in cases where use is made of former dies and the guide pin of the die sinking machine.

When it is probable that there will be but few dies needed for any particular job it may not be expedient to make the duplicating appliances mentioned, but when there is a prospect that there will be a continued demand for a certain kind of dies it will be found advisable to provide them. After some experience in their use, as their advantages become apparent, as they will very quickly to any one who has run a profiling machine, they will gain favor.

Former dies for temporary use may be cast in hard babbitt upon a model forging which has been fitted up for the purpose with the allowance of this extra shrinkage, or non-expansive metal may be used for the purpose if it is at hand, which may be cast on the standard model forging which has been fitted up with the usual allowances for shrinkage. When this die has been proved to be correct in form, a steel former die may be cut out by it for permanent employment. The use of these appliances changes the nature of the work from that of a special to a regular manufacture.

A remark has been going the rounds of the press to the effect that mechanical operations are of such a nature that they cannot be hurried. This statement in a well considered article by a careful writer could not have been intended to convey the inference which may be taken from it, for no one knows better than he that the performance of machines depends greatly upon the ability as well as the disposition of those who run them.

The principle of sinking dies expeditiously and well is to rough them out or remove the surplus stock as the first aim, and to go as close to the finish line as possible without the taking of so much care as to interfere with getting the stock out of the way in the quickest manner. For this reason it is good practice to have the taper which has been determined upon for the draft of the dies made upon all the cutters which are used, for that precaution will insure that as long as the upper side of the cutter is kept from encroaching upon the profile of the impression which is in sight, the lower part of the cut will not intrude upon reserved premises and leave marks which a finishing cut will not remove.

When the lines from top to bottom at the sides of the impression are not straight, the shape of the cutters must, of course, be modified to suit. For instance, if there be an impression to cut to admit half of a 1½-inch cylindrical piece with half-round ends, it is evident that as the shape of a cutter which would take out the whole size and depth at one cut would be hemispherical and regular, the shape of a cutter to take out one-third of the depth at one cut would be very different from that to take out the second third, and each of these would differ greatly from the shape of the one required to remove the last third. These three cutters would look very different from each other because although the longitudinal cross-sections of all were bounded by arcs of the same circle the chords of these arcs would be inclined at various angles to the axes of rotation, and neither of them would accurately cut the side of the impression at any other depth than that for which it was especially shaped Each of them could be made of considerable less diameter than the cylinder, but neither shape would be particularly well adapted for routing.

It would not pay to make a routing cutter of either of these forms. Any roundness or beveling of the bottom of a cutter, except the removal of the sharp corner, is not of

benefit to its capacity to remove stock. A plain $\frac{3}{8}$" or $\frac{1}{4}$" straight cutter will answer the purpose and remove the most of the stock in this case with rapidity, leaving a ridge of $\frac{1}{8}$" steps up the sides and ends. A hemispherical cutter of the diameter of the cylinder can be used to clear this out and finish up the impression.

In using straight cutters to rout stock from impressions which have not straight sides the advantage of using a former die and guide pin are very obvious, as their use, if the guide pin corresponds, as it should, to the shape of the cutter, will prevent any liability which might otherwise exist of making intrusive cuts, but when these advantages cannot be economically obtained the depths to which each cut can safely run may be determined by the depth lines drawn at the end of the die, and gauged by any stops or attachments for the purpose which belong to the machine.

The economy of making former dies depends greatly upon the experience and skill of those who make them. As long ago as 1858 in a shop where they were duplicating the gun stocking machinery of the United States for foreign governments it was necessary to make steel former dies to serve as guides for letting the various parts of the guns into the stocks. An examination of the recessing for the admission of the lock will show the difficult form of the dies. The die-sinking machine was used for the purpose, and matrices were cast in each case in soft metal to originate the dies. They were as perfect as printing type, and the steel dies generated by them had a like degree of perfection.

The cutters used in the die-sinking machine are principally of the kind known as "shank" or "stem" cutters, the cutter being solid with the shank. Teeth are cut on the periphery and usually on the end. Cutters which are not too small to make it practicable have a short recess in the center to avoid cutting the teeth clear to the center and to make them clear chips better. If this recess is a drilled hole the drill should be ground with round corners; sharp corners leave marks dangerous to start fire cracks.

Although there is more value to risk in putting a many-edged tool like a milling cutter to work on hard material than in using a single edge like a chisel or planing tool, yet it sometimes proves that the many-edged tools possess some advantages that will warrant their employment on steel, which could not be worked without annealing with a single edged tool. That these advantages are not all derived from the circular shape of the tool and curvilinear line of motion of the edge, may be argued from the fact that multiple edges working in straight lines show equally good results. This may be observed in the performance of that mechanical revelation—the power hack-saw. In one instance where a power hack-saw was used there were seven pieces of $3\frac{1}{2}$" round steel sawed off in two hours at the expense of two saw blades. As was the custom the saw was left to itself and no attention paid to it except to set it again after each piece was severed; but when this steel came to be worked it was found to be so hard that it could neither be turned nor drilled until it was annealed.

It may be said that the teeth of the hack-saw were harder than the teeth of milling cutters, but there is no reason why the edges of milling cutters should not be as hard as the teeth of a hack-saw. No one trusted with the use of a die-sinking machine would run a cutter up against a sharp square corner so abruptly as to get a bite that would break out the teeth, and in its regular legitimate work there is no percussive shock that should cause crumbling to the properly shaped edges of the cutters.

Different kinds of steel require different modes of treatment. Some steel is very delicate. A very good shank cutter is one that is tough and hard to break in the neck—if it has a neck—and has the edges perfectly hard without brittleness. To obtain hard surfaces without hardening deep some temperers have heated the tools to a low, red heat and applied cyanide of potash to them until the melt spread over them and then quenched them in oil. There is a mineral oil, sold especially for hardening, which gives surprising results. This treatment left the stem tough and the teeth hard. The distortion by this hardening was so insignificant that no grinding was required to true them up, and as only the face of the teeth needed to be ground for sharpening the extreme edge of the tooth, due to the outside unground surface, remained in its hardest condition for cutting.

Milling cutters can be used with harder edges than chisels because they are not subject to percussion; they do not lose their hardness through friction, like drills which remain in constant contact with the cut, and they will therefore perform their operations efficiently in removing stock from steel blocks which are too hard to be worked with other tools. In hard stock the teeth can be cut finer, the speed can be less than in soft stock. There is no advantage gained in having too many teeth of a mill engaged at once. The utmost that a cutter can do is to fill its teeth and discharge them at each revolution; when they are full they will not take any more and they do not work well when cutting too large a part of their circle. If half the teeth are cutting at once there is only half of the revolution available for the chips to get out; yet in die-sinking, in making the first routing cut through the impression, it is necessary to take this form of cut. It is a cut retarded by clogging, and for this reason the cutter used should not appropriate an undue share of space to the teeth, but leave ample recesses for the cuttings. For this purpose it is probable that six teeth in a $\frac{5}{8}$" cutter will be generally satisfactory; for harder material seven to ten might not be objectionable. This plowing cut may be taken with any sized cutter, not too large, that will make the greatest headway. The depth of the cut is governed by the size of the cutter.

Wherever a straight cut is to be made in any direction, without using the guide pin, it is better to take the trouble to swing the bed so as to bring the cut in line with one of the feed-screws than to depend upon making it by a correct proportional movement of two of them. Such an attempted resolution of forces is apt to produce marks of irresolution on the milled surface. The setting may be promptly and accurately performed if simple arrangements are made and provided which will determine, in any desired place on the face of the die, the parallelism of the screws. If the angle is ascertained the setting can be done by the index circle.

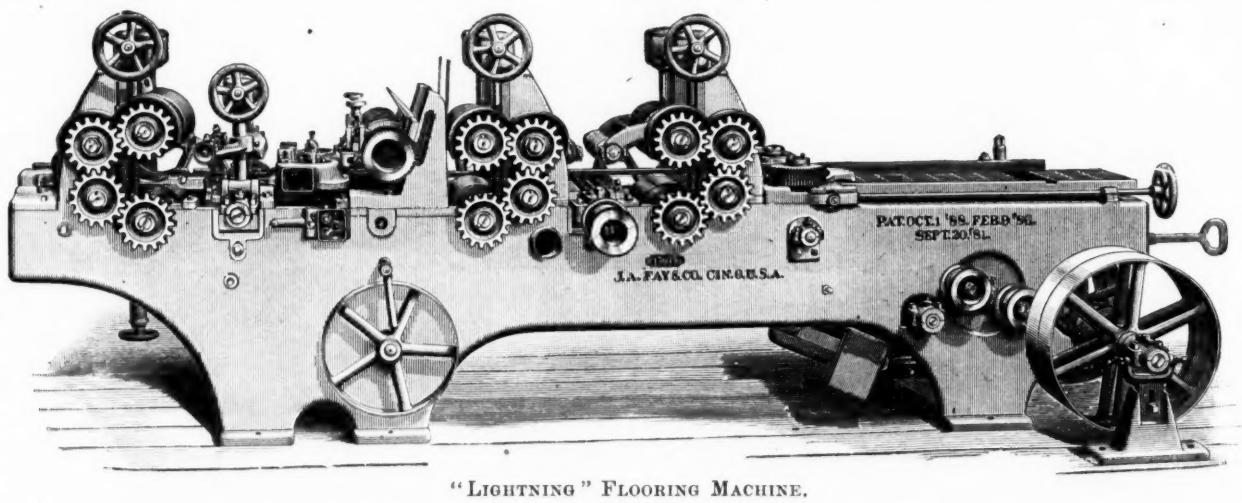
More trouble is experienced in setting a die to make a bottoming cut not parallel with the bottom of the die, but the necessity for so doing is imperative in any case where the cross-section is flat-bottomed, and scarcely less when it is of a regular curve, unless a former die is used; if it is, and the course is thus guided, the end of the cutter may be so shaped as to cut the required curve with a single cutter in some cases, and these will be those in which the curve is not too shallow for the steepness of the incline. It is more direct and practical to cant the die and make a level cut.

There are sometimes cuts to make which will not permit the use of anything at the deepest part of the cut but a very delicate cutter. Say the cutter is half an inch deep, $\frac{1}{4}$" across the top and $\frac{1}{8}$" across the bottom, the teeth in the point would be quite small, and if running at a fair cutting speed—30 feet per minute—would have little time for clearance—about $\frac{1}{2000}$ of a minute for each edge to deliver what it accumulated in an equal period. A single-toothed cutter might be used; three teeth would be better; some would use six. If it advanced $\frac{1}{100}$" at each revolution it would move at the gratifying rate of an inch a minute. It would be better in this case to make three cutters to displace the stock at three or more cuts, each cutter as large as the portion of the cut which it makes will permit, and there will be better progress. Nothing that has been said is to be taken as objecting to going over every surface with a fine finish cut; the plowing cuts should leave stock enough to take a light cleaning cut on each side with a cutter cutting the full depth of the impression.

Shank cutters sometimes cause trouble by working out, getting loose and dropping from their proper position, either on account of the condition of the cutting edges, the form of the teeth, the fitting of the shanks into the sockets, the too great taper of the socket hole, the inequality of the steel operated upon, an uneven bearing of the cut which causes slight but continuous flexion of the shank, and other circumstances which operate with the well-known tendency of all jarring to produce looseness. Many expedients have been proposed and adopted to obviate this difficulty. Efficient measures must be taken to guard against all these causes, as accuracy in the depth of the die is dependent upon the cutters remaining in their place. It is not as easy to see what the cutter is doing on the bottom as on the sides, and the operator cannot be assured on this point unless he is certain that his tools do not drop.

There are objections to using straight untapered shanks fastened in collets by set-screws; preference is given to taper shanks fastened by their friction in smooth quill sockets fitted in the spindle. In regard to the taper of the shank socket it was noticed that altering the taper by decreasing it from $\frac{5}{8}$" to $\frac{1}{4}$" to the foot, satisfactorily remedied the evil. In another case it was observed that when the danger from loosening of the tools had been fully impressed upon the maker of them he fitted them so well that the trouble hardly ever occurred. "Hardly ever" is not sufficient—it should never occur.

The teeth of a straight and of a spiral cutter may be cut to the same angle, but there are two reasons why a right-handed spiral cutter will cut better than a straight one; one is that it presents a sharper edge to the work, and the other is that it clears itself of chips better. The same motion that tends to lift out the chips also tends to draw the cutter out of the socket. It is also more difficult to grind. Cutters with left-handed spirals have a tendency to crowd up and are not objectionable on that account, but they do not clear well. Cutters with the teeth parallel to the axis are generally used, are easily ground and nothing better is commonly required. The first thing to do in sinking dies with cutters is to drill the holes from which the milling cuts for the removal of stock are to start.



"LIGHTNING" FLOORING MACHINE.

"Lightning" Flooring Machine.

The machine shown herewith has recently been especially designed for the production of flooring; it will produce from 20,000 to 30,000 feet per day, according to the character and width of material.

The cylinders with their journals are made of solid forged steel, slotted on four faces and with chip-breaking lips for working cross-grained lumber, rustic siding, etc. The journals are $2\frac{1}{4}$ inches diameter. In the triplex-cylinder machines (like cut) the first cylinder is arranged between the first and second pairs of feed rolls, and finishes the under side of the lumber before it reaches the upper cylinder and bed-plate. This method insures a smooth surface of the under side of the lumber while passing over the bed-plate of the upper cutting cylinder during the process of planing to a true thickness. The result is smooth work even with a high speed of feed, as there is but little reduction for the last or finishing cylinder, just before the feeding-out or delivery rolls, to perform. All the cuts upon the lumber are made relatively near each other where the machine is the strongest, heaviest and best able to withstand vibration. The bearings of the upper cylinder are planed to fit upright stands which are cast solid with a bed extending across the machine, being by this means rigidly tied together. These stands are made with grooves in which the bearings are bedded, which keeps them in line. The lower cylinder is arranged in front of the last pair of feeding rolls close to the matchers. It also is mounted in a heavy frame with delivery spout for shavings, and has vertical adjustment by means of a crank and screws.

The pressure bar before the cut or on the feeding-in side of the upper cylinder is attached to swinging arms by which it is brought close to the edge of the cutters, thus preventing tearing and splintering of cross-grained and knotty stock. This bar is so attached to the swinging arms that it can be set forward or back to admit of the use of molding or drop-siding cutters. The pressure bar after the cut is also adjustable back and forth. The pressure bars before and after the cut are adjustable for projecting bits. The matcher heads are made of gun metal with steel screws and are provided with solid milled matching cutters; they are so arranged that a deep rabbet can be cut for drop-siding. Hoods are provided for directing the shavings away from the operator; exhaust pipes can be attached for removing shavings by means of a fan.

The arbors for the matchers are of steel $2\frac{3}{16}$ inches diameter and $1\frac{1}{2}$ inches diameter where the side cutter-heads are received. The self-oiling bearings are adjustable laterally across the bed-plate, and the arbors are provided with means of adjustment vertically. Each matcher hanger is fitted with a graduated gauge to facilitate adjustment for different widths of stock. The matcher clip with steel chip-breaking clip is hinged to the hanger and a weight is employed for securing uniform pressure.

The feed works consist of six large rolls, two pairs before the main and one pair after the lower cylinder. The rolls are mounted

upon upright stands, fitted with socket joints and connected by expansion gearing.

This machine, as previously intimated, is of new design and contains several features of novelty that have not been referred to in this description. The weight of machine, double-cylinder, is 8,000 pounds; triple-cylinder, 9,000 pounds.

The manufacturers are J. A. Fay & Egan Co., Cincinnati, O.

Wants to Know About Solder.

A foreign correspondent writes us as follows: Perhaps some of our readers can help him.

"The repairer of sewing machines is frequently compelled to solder small pieces of steel, steel wire, steel horns, etc., to finished parts of sewing machines; for instance, shuttles, spool cases, tension parts, etc. It is not prudent to use hard solder for this, as in this case the article must be heated too much, which sometimes causes a change of form and a ruin of the finish. Tin solder does not give satisfaction; the work done with it is not durable. Can you name me a composition of solder which answers both purposes, which requires not so much heat to deform the article in question, and in other respects gives good durable work?"

Vise Clamps.

BY H. HARDINGE.

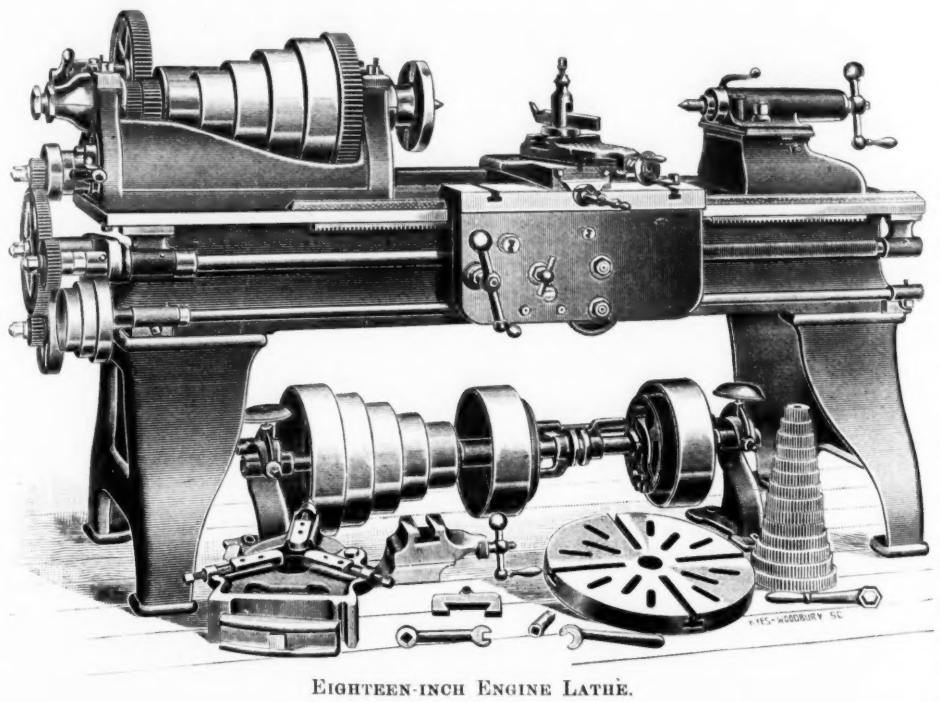
In your issue of May 25th I notice an article on vise clamps. Vise clamps are, under certain conditions, an unavoidable and regretable necessity, as in the case of a great deal of heavy vise work where a workman is always vibrating between chipping and draw-filing. I can only say get the best, and the best I have used up to date are copper. The kind you mentioned may be better, I hope so anyway, but I fancy the spring would be somewhat limited in its scope. The great objection I have found with clamps of every description is the fact that if they are hard enough to stand the pressure they are soft enough to allow filings of all kinds to imbed themselves in them, and in a short time are almost as bad as the vise itself to deface finished work. So, for the last five or six years, I have made a practice of grinding the teeth out of every vise I have used. It can be done by hand on an ordinary emery wheel by using proper care. I grind the jaw faces as near correct as possible (they are often not so when new); letting them come together first at the upper edge if any advantage is given; you will then have two hard flat surfaces that no work will injure, and that will not injure the work, no matter what the character or how tight it is held, within reason. Since I have adopted this method clamps are a reminiscence with me and only serve to show me how little I knew about handling tool work to advantage. That toothless vise is a never ending source of satisfaction to me, and I think the manufacturers of vises would do well to make them both ways and advertise them as such, for there is nothing else in it for the tool maker or any mechanic who values his time and his work.

Eighteen-inch Engine Lathe.

A new pattern 18-inch swing engine lathe has been put on the market by F. E. Reed & Co., Worcester, Mass., which is shown in the accompanying engraving.

The bed is of more than ordinary depth for a lathe of this swing, and in other respects the lathe is heavy and strong. The outside Vs are made larger than the inside ones to give increased wearing surface for the carriage.

The head spindle is made from a crucible steel forging, and has a straight, smooth hole through it. The front bearing is $2\frac{13}{16}$ inches diameter and $5\frac{5}{8}$ inches long. The bearings are cast-iron lined with genuine babbitt metal. The cone pulley has five steps for $3\frac{1}{2}$-inch belt, the largest step being 12 inches diameter.

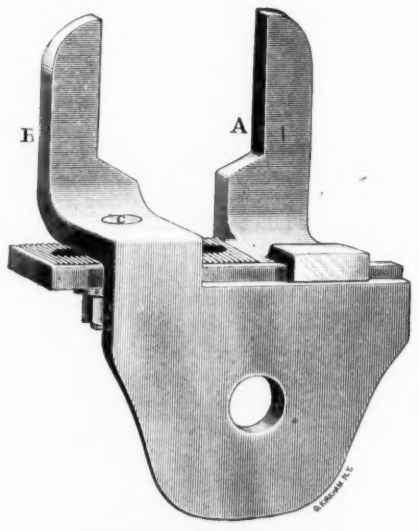


EIGHTEEN-INCH ENGINE LATHE.

The rest has long bearings on the Vs and is firmly gibbed front and back. The feed works are driven by variable friction feed; also supplied with a patent feed which admits of a large range. The power cross feed is so arranged that the gearing does not lock in with the lateral feed in case both feeds are in operation at the same time.

The leading screw is made of steel, from an accurate master screw, and is operated in connection with an open and shut nut. The rack and pinion is arranged to disengage pinion from rack when cutting screws. The foot-stock is strong and substantial with large spindle and ample bearing on the bed to correspond with the other parts of the lathe.

Each lathe is carefully inspected before shipment. Weight, with 8-foot bed, 2,665 pounds.



IMPROVED LATHE DOG.

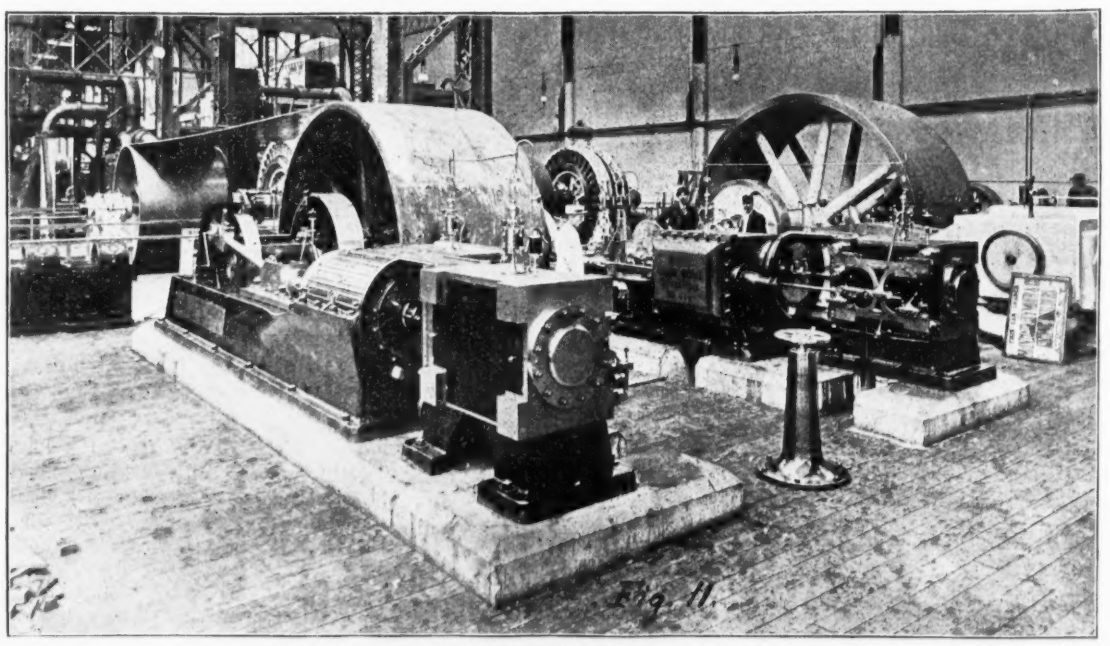
Improved Lathe Dog.

The accompanying illustration shows an improved lathe dog, well adapted for turning bolts with square or hexagonal heads, or studs having ends of a polygonal form. The lower flange of the jaw *B* is bolted to the face-plate of a lathe; the movable jaw *A* slides on a guide, which is a part of the jaw *B*. The upper serrated surface of the extension of *A*, as shown in the illustration, is made to fit with a similar surface on the under side of *B*, and the two are firmly clamped together by means of the stud as indicated. With this arrangement the jaws can be readily adjusted to suit any size of bolt head or work.

It will readily be seen that a lathe dog of this kind will avoid the necessity of keeping on hand a number of the ordinary ones, for a certain run of work, and which are liable to get scattered and cause vexatious delays in finding the right one when wanted.

The lathe dog here illustrated is small, simple in construction, and durable; it can be kept in a handy place, and all unnecessary delays in looking for lathe dogs when wanted avoided.

This device is the invention of Wm. Moore, and J. W. Parker; it is made by Wm. Moore. 313 Third St., Manistee, Mich.



ATLAS ENGINE.

Columbian Exhibition Notes.

Editorial Correspondence.

THE ATLAS ENGINE.

At Fig. 11 is given a view of the Atlas engine which is built by the Atlas Engine Works, of Indianapolis, Ind. It is a double tandem compound, the high-pressure cylinders being at the rear and the low-pressures nearest the cranks. The cylinders are 14 inches and 24 inches diameter, and 30 inch stroke. The engine runs at a speed of 150 revolutions, and is intended to develop 1,000 horse power, its work here being to drive a Westinghouse 1,000 incandescent light dynamo. Its fly-wheel is 12 feet diameter, and the belt which runs upon it is 6 feet wide.

As far back as the rear end of the low-pressure cylinders this engine is about as shown in our illustration of the Atlas engine, issue of June 11, 1891, except that the valve instead of having beveled or angular sides, as there shown, has square sides. The high-pressure cylinders, however, have something new in the way of a valve motion, the nature of the innovation being indicated by what can be seen at the side of the right-hand high-pressure cylinder in the engraving, where it will be seen that there are four valves which are placed like the Corliss valves. They are oscillating also like the Corliss, but there is no detaching device, the end of the valve stem cranks carrying rollers which engage with cam grooves formed at each of the four corners of the rectangular frame seen at the side of the cylinder, the motion of this frame being controlled by the eccentric, the motion of which is in turn governed by the shaft governor, which operates to give the eccentric more or less throw. The cam grooves referred to are in form something as the sketch, Fig. 12, indicates, where the dotted circle represents the roller which runs in the

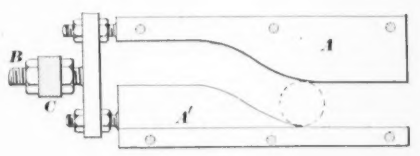


Fig. 12

cam, and thus opens and closes the valves. Except when the engine is cutting off unusually short the rollers always travel beyond the curved portions of the cam groove into the straight portions, and the valve is consequently always fully opened even for the shortest cut-offs that are expected to take place in practice, the length of time which the valve shall remain open depending upon the distance moved by the cam while the roller is in the straight portion of the groove. The pieces *A A'* in the sketch, Fig. 12, which I have not made to scale, but merely to show the principle of construction, are movable lengthwise in the H frame, and can be adjusted independently to take up lost motion by turning the nuts which are upon the smaller studs, or, they can be moved together in the frame by turning the nuts on the central stud *B* which passes through a lug *C* on the H frame this being for valve adjustment. Small bolts put through the pieces *A A'* and the H frame secure them in place when adjusted. There are five ports in the valve and the same number in the sleeve which forms its seat. Thus the valve seat is bushed and may be readily renewed. The ports in the valve and seat are milled, and at the same time with the same milling cutter, slight grooves are formed in the end of the valve and seat which, of course, exactly represent the ports, so that by removing the cap at the end of the valve,

the amount of port opening is shown. I happened around when one of these caps was off and the engine was about 15° off the center; there was practically a full port opening at that point. The frame in which the cam grooves are formed is supported upon two brackets which are bolted to the side of the cylinder, and the valve stem can be disconnected for working the valves by hand with the starting bar, which is shown in position. The engine is running with an independent condenser which is below the floor.

THE BATES-CORLISS ENGINE.

Driving a section of the line shafting there is an engine known as the Bates Corliss which, though it is located in rather an obscure position (back of the ornamental sewing machine pavilions) yet attracts considerable attention, because it has something new in the way of a modification of the Corliss valve motion—a device which, while it performs the functions of a release or trip, yet does not release. It certainly is simple in construction, and there seems to be decidedly less chance for deleterious wear of the parts of the valve motion than there can be with the usual releasing devices.

At Fig. 13 is a diagram which will make the construction and operation readily understood. From this it will be seen that there is the usual wrist-plate with the connections to the exhaust valves arranged in the usual way, and there are the usual dash-pots and their connections to the steam valves.

But the wrist-plate attachments to the steam valves are permanently attached at *O O'* by steel wrist-pins with regular stub ends on the rods. At the other ends these rods are curved downwards as indicated, and are attached to the steel wrist pins *P P'*, these pins being fixed in links *L L'* which turn freely upon the pins *I I'* which are fixed in the wrist plate. The rods running to the governor are attached to separate arms, as indicated, one below and the other above the center of the wrist-plate, these arms or levers being attached to rings upon which are also the arms carrying the rollers *D D'*, these being made to approach or recede from each other by the action of the governor to vary the cut off. The lines *C C'*, which are drawn from the centers of the wrist-pins *O O'* to the centers of the wrist-pins *I I'*, show the lines of strain between the pins. Now supposing the wrist plate to be in motion to the left as indicated by the arrow, the link *L'* at the right-hand side is in the position in which the valve will be moved by the connection. But when the link *L'* comes into contact with the roller *D'* as shown, the motion of the arm *L'* is arrested, and when by the continued motion of the wrist plate the pin *P'* is brought slightly above the line of strain *C'*, the link *L'* turns quickly to the right upon the pivot pin *I'*, and the dash-pot closes the valve. The motion of the wrist-plate continuing to the left the wrist pin *P* goes below the line of strain *C* until the connection *R* strikes upon a cushion provided for it upon the link *L*, when it is locked and prepared to open the valve at the left when the motion of the wrist plate is reversed, until similarly tripped by the roller *D*. The motion is absolutely noiseless except for the familiar piff of the dash pots, and it must be conceded that there is originality in it, and that it has some excellent features, not the least of which is that it is probably relatively inexpensive to construct and maintain. It is new yet, and may develop special weaknesses of its own as it grows older, but the best and most experienced engine men here with whom I have talked of it, refer to it in the highest terms for its originality and apparent excellence. Either of two forms of steam valves are fitted to this engine, the form recommended being that shown in the partial section, Fig. 14. It is a flat valve which is moved by links connected to the lower ends of two arms *A* which are fixed on the transverse shafts above, which correspond to the valve stems of oscillating valves. The arrow shows the course of the steam over the valve and into the port to the cylinder.

In other respects the engine seems well designed and constructed, the bed being

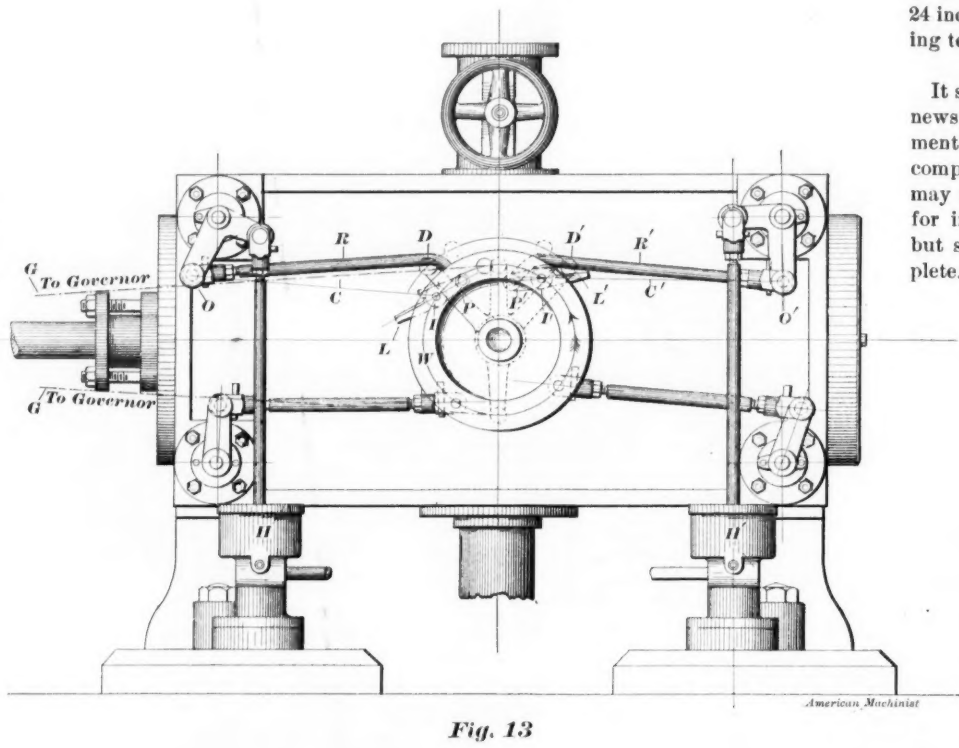


Fig. 13

square or box form in section instead of T section, which gives it great strength, neat appearance and the advantage that it is practicable to provide an opening through the web at the back of the cross-head opposite the cross-head pin through which opening it is easy to get at the pin from the back side in removing or putting it in place.

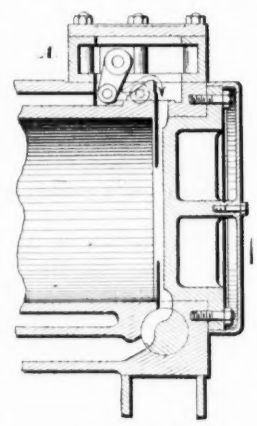


Fig. 14

The engine running here is simple non condensing with cylinder 20x48 inches, and runs at 64 revolutions, driving textile machinery, mainly. It is designed, however, to run at 75 revolutions, and to develop 296 horse-power with initial steam pressure of 100 pounds and cut off at ¼ the stroke. It runs at the lower speed named, because the pulleys are so arranged that it must in order to drive the shafting at the proper speed. The engine is built by the Bates Machine Company, Joliet, Ill.

THE GOLDEN STATE ENGINE.

Another engine which possesses the feature of novelty in a marked degree is that built by the Golden State and Miners' Iron Works, of San Francisco, Cal. In general appearance it cannot be said that this engine is a pleasing one judged by modern standards in such matters. I expect, however, that while it is hardly "the best engine ever built," as its builders are unwise enough to declare it to be, its steam distribution may be excellent and as good as that of many engines that are better known and are neater in appearance. Its valve motion will be understood from the accompanying sketch, Fig. 15, which shows what is attached to one end of one cylinder; the same being attached to each end of both cylinders; the engine being a tandem compound. The main valve stem is shown at *A*, this stem being attached to the single eccentric from which the motion is derived. To this valve stem the exhaust valves *P* are attached; the movement of these being uniform and fixed. Clamped to this valve stem are the arms *B*, which, as they move back and forth, are adapted to engage with the trigger *C* which is pivoted within the steam valve stem *F* at *R;* part of this steam valve stem being broken away to show the position and form of the trigger, an upward extension of which carries the roller *T*, which, in passing over the wedge *D*, is raised, and thereby disengages the trigger from the arm *B*, and allows the valve to be closed by the steam pressure acting on the valve stem *F*. The dash-pot which cushions this motion is at *J*. The point of cut-off is, of course, determined by the position of the wedge *D*, and this is controlled by the governor; the connection to which is indicated by *O*. With the valves in the position shown, steam passes through the port *M* into the chamber below, from which it passes to the cylinder; the exhaust port being covered by the exhaust valve *P*. It is said that there are those who object to the Corliss wrist-plate motion on account of its looks; though this seems hardly possible where the motion has been studied sufficiently to understand its principles and the results attained by it. The Golden State engine gets rid of the wrist plate motion, certainly, and it uses "plain, flat valves." The engine running here has cylinders 14 and 22 inches; stroke, 24 inches, and runs at 114 revolutions, driving textile machinery, mainly.

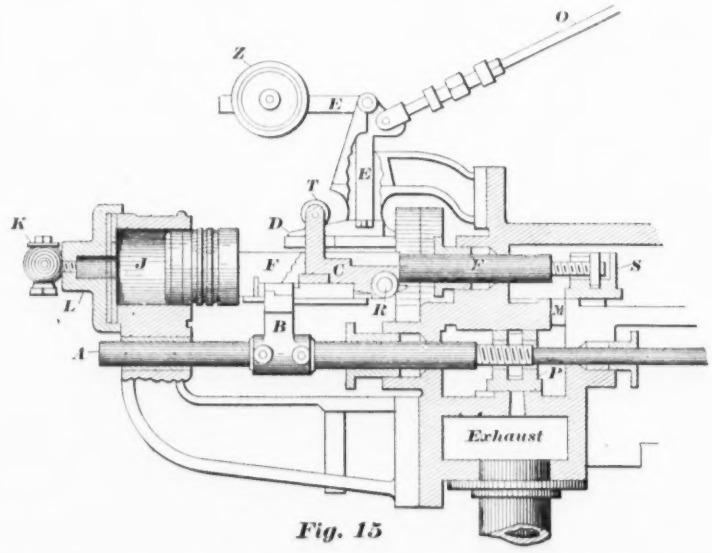


Fig. 15

It should not be inferred that because the newspapers announce that a certain department is formally opened, it is therefore complete in all respects. It may be, and may not be. Take the Electrical Building, for instance; it has been formally opened, but some of the exhibits are as yet incomplete. There is much to be seen within the building that is of scientific interest, and much that is merely showy and spectacular. I hope I may be pardoned for saying that I think, however, that the best display of electrical engineering is in the Machinery Hall, where the big dynamos and switches are, and that much that is in the Electrical Building more properly belongs in the Manufactures' and other departments. It is quite apparent too that there has been considerable effort to get the building filled, and much that is in it does not pertain to electricity at all, while much else is humbug, pure and simple. In the former classification may be placed an exhibit of pianos which are played by turning a crank, and some displays of engineers' field instruments, about which there is no electricity or magnatism, except that which may act upon the magnetic needle used in some of them; while in the latter classification can be placed the magnetic belts and other magnetic appliances which are offered for the use of people who are foolish enough to diagnose their own cases from the reading of advertising matter, and then prescribe for themselves. Pictures of the philanthropists who run these exhibits form a prominent feature of them, as is to be expected, though in this they have an example in the exhibit of the "Wizard of Menlo Park." The space occupied by the exhibits in this department forms a painful contrast with that accorded to the home machinery exhibitors in Machinery Hall, *i. e*, painful to a machinery man, not to an electrician probably.

The line shafting in the British section has not been running for several days, and the Galloway engine has been standing still. Upon asking the engineer in charge the reason for this, he said I could find out all about it by looking at a letter and notice posted on the bulletin board at the door of the chief engineer of the British Commission. The letter proved to be from Mr. Foster who is at the head of the Mechanical Engineering Department, and is addressed to the British engineer. It stated substantially that the line shaft driven by the Galloway engine had been moved out of line by the traveling crane, and that it would therefore be impossible to run until the defect had been remedied. That by a mistake the traveling crane had been allowed to run on the runway over the shaft and had displaced it; that he was consulting with the Chief Engineer of Construction as to the best way of securing it, and as soon as this had been done the shaft could again be turned. Knowing that the crane (in this instance the Yale & Towne) had been designed to run on the runway over this shaft, I walked down to the other end of the building, where I found the Yale & Towne man, who erected and is in charge of the crane, oiling up. He was surprised to be informed that he had displaced the line shaft, and said that he had had no orders not to run over the runway at the other end where the Galloway engine is, either before or since the displacement, and proved it by inviting me to accompany him on a trip to the other end over the engine, which I did, and we got off when there and examined the position of the wheels on the T-

rails which are placed on top of the runway. There was no crowding or other indication that the crane tended to displace anything, except possibly by its weight. There was plenty of indication at various points, however, that the structure composing the runway is not as stiff as it should be—that a tight horizontal belt can pull it out of alignment, and that an unbalanced pulley can make it shake in a very unpleasant way. This can be observed still better from the floor when the crane is not near, because the crane ties the two opposite runways together, stiffens them considerably and diminishes the vibration.

When the weather is at all warm, Machinery Hall is insufferably hot, especially in the Annex, where the ventilators which run along at either side of each bay near the top have been closed with canvas to keep out the rain, thus shutting off ventilation, and confining the air which becomes heated by the sun shining through the glass roof, and by the steam pipes under the floor. A petition for relief, signed by a number of exhibitors, was presented to the Department of Machinery, when Mr. Porter, the Assistant Chief, explained that the Department of Machinery could do nothing about this, as it was a matter coming within the jurisdiction of the Department of Construction. The incident explains a great deal that may otherwise be somewhat mysterious. The Department of Construction has charge of all matters pertaining to the construction and maintenance of the buildings and grounds with their appurtenances; the head of this department being Director of Construction Burnham. The chiefs of the departments who have to do with exhibitors directly are in the department presided over by Director-General Davis and to put it mildly, there has been and is considerable lack of unity and absolute harmony of action between the two departments with all their ramifications. From this arrangement it follows that the Department of Machinery is entirely separated from the Bureau of Mechanical and Electrical Engineering, the latter being a part of the Department of Construction. This is why Chief Robinson finds his hands tied in many particulars where the chief of that department should be free to act and have authority with responsibility.

It explains also why neither Chief Robinson nor Mechanical Engineer Foster have authority to go to work and strengthen the runway or adopt a plan to secure it in place without consulting the Chief Engineer of Construction. It is extremely difficult in many cases for one to decide whether a given thing or a given piece of work belongs to the Machinery or to the Mechanical Engineering Department; or whether it belongs to either of them or not; and some of the men who stand high in these departments tell me that it is often very difficult for them to decide, and that serious trouble (not mentioned in a very serious manner, however), often results from this inability to distinguish instantly the various domains. The extreme difficulty of doing work efficiently and well under such circumstances will be readily perceived.

A tempest of considerable proportions seems to have developed among the British Government representatives here, and it has finally become so violent that there are rumors to the effect that nothing but considerations of the dignity of the Commission and the responsibility devolving upon its members to maintain that dignity prevents something in the way of some very American public horse-whipping. The story is too long for repetition here; but suffice it to say that Sir Henry Trueman Wood, who is the paid secretary of the Commission, seems to have gotten it into his head that he is by far the biggest man who has anything to do with British affairs here, and has let no opportunity escape him for humiliating and trampling upon Messrs. Dredge and Harris, the Royal Commissioners, who have finally concluded that matters here have been made unbearable by Wood, and they are about to sail for England to ascertain from the authorities there, if they have any rights left which Wood is bound to respect. I do not happen to know much of Commissioner Harris, but everybody knows of James Dredge as the editor of *Engineering*, the friend of America and of American engineers, and the man who more than all others put together has worked to secure from England an adequate representation here. It is true he has lamentably failed in this, so far at least as the machinery exhibit is concerned; but that is not his fault, and that such a man should be trampled upon and insulted by a petty official nobody, is very much to be regretted, and everybody here hopes that Wood will be recalled and taught a thing or two which he seems to need to know. F. J. M.

Jackson Park, June 12.

Improved Double Radial Borer.

This machine is intended to bore two holes at the same time at any angle from the horizontal to the vertical, and any distance apart between centers from 1″ to 16″. It is

DOUBLE HEAD RADIAL BORER.

particularly recommended for doweling chair, cabinet, carriage, car and other similar work.

The frame is cast in one heavy piece, has a large well-expanded base, and will stand firmly and solidly on the floor.

The two spindles are mounted on a radial frame, which is substantially fitted in a bored out socket, and can be readily secured at any angle. One spindle always retains a central position, while the other one is adjustable by a hand-wheel and screw on planed dove-tailed ways. A handy clamping nut is provided to secure the same when set.

Both spindles and their pinions are made of a fine grade of steel, and revolve in long carefully fitted bearings. The driving gear is carefully cut and matched, so there will be little or no noise or jar caused by improper fitting.

The large intermediate gear revolves on a stud, which is fitted to a radius arm, so arranged that it keeps all gears in proper mesh with one another. By slacking a nut this gear may be thrown out of mesh with both spindles, so that a single spindle may be used at any time without running the gearing.

The table is gibbed to the column on dove tailed ways, and is raised and lowered by a convenient hand-wheel and screw. The table is moved to and from the bits by a treadle and lever, the arrangement of which is very simple and requires no loosening or fastening of nuts or bolts whenever the vertical position of the table is changed. A countershaft is furnished with each machine. The manufacturers are Cordesman Machine Co., Butler street, Cincinnati, O.

LETTERS FROM PRACTICAL MEN.

Cam Rollers.

Editor American Machinist:

Up to date the cam roller stands in the AMERICAN MACHINIST as follows:

In 1892, September 15, p. 5, Mr. Pentz, writing from abundant practice with small cams, showed a cylindrical cam roll.

November 10, p. 6, Mr. Durfee says the cylindrical cam roller is "absolutely wrong," claims to be an original, though not first inventor of the conical cam roll, and says, incorrectly, that the frustum of a cone having its vertex in cam axis avoids "grinding action," that is to say, makes cam groove and roller travel identical at co acting points.

December 1, p. 7, Mr Leonard objects to friction at stud shoulder of conical roll.

December 7, p. 7, Mr. Gribben makes same objection.

December 22, p. 7, Mr. Severance forcibly objects to conical roll as inaccurately transmitting motion under heavy labor.

December 29, p. 6, Mr. Durfee again declares unqualifiedly in favor of conical rolls, failing still to note varying velocities of roll and groove travel at co acting points, and further claims to be the first to describe a "floating" step bearing, first used, so far as I know, by Mr. Mason, late of Taunton Locomotive Works, very early in his life, and treated at some length in Appleton's Cyclopedia, p. 819, Vol. 2, Ed. 1881.

In 1893, January 5, p. 7, Mr. Hardinge says the "conical roll has the merit of being theoretically correct, if nothing more," and has seen hard cylinder rollers and studs ruined by differing velocities of roller and groove surface.

January 12, p. 7, Mr. Durfee replies sarcastically to Mr. Severance's question, "For what purpose is a cylindrical cam roll absolutely wrong?"

February 2, p. 6, Mr. Pentz points out right line travel conditions essential to theoretically correct cone roller action, and specifies wide experience which has led him to condemn conical rolls in decided terms for high speeds.

February 2, "M. E." also notices cone clutch rolls, not cam rolls, badly worn at the shoulder.

February 16, Mr. Hardinge thinks cam rollers do not roll because the roll has more area of contact on the roller stud than on the cam groove face, which is a surprising error.

February 23, Mr. Robinson, Ohio State University, correctly commends the idea of fitting cone rolls, if used, on cone roller studs, shows that cone rolls can never be theoretically correct in "side" cams as in extreme action the form should be a cylinder, and in total inaction a cone, and also that under certain assumed conditions the cylindrical roll is the more likely to revolve.

March 2, p. 5, Mr. Durfee supposes that cylindrical rolls really become conical rolls through wear, and are thus enabled to work in spite of bad design, he evidently not yet having discovered the theoretical incorrectness of the cone roll.

March 2, p. 7, Oberlin Smith notes his publication October, 1885, of the incorrect action of conical roll and "side" cam groove, same as Mr Robinson; says that in "most cases a cylindrical roll is preferable, and concludes with his voice in favor of cylindrical rolls with short faces, and as large diameters as possible, especially in light work, from which last proposition I entirely dissent.

March 9, Mr. Pentz acknowledges his error and Mr. Robinson's correctness as to "theoretical perfection" of the conical roll.

March 16, Mr. Stedman contradicts Mr. Pentz and says that "periphery and face cams fitted to take up wear and with slightly coned rollers have been in successful use in sewing and embroidering machines for several years."

March 30, I wrote under what now seems to me the incorrect impression that a conical mill did not cut a cam groove in a "side" cam which was of uniform section, and hence a so-cut groove could not be filled at all points by a cone roller. Having noticed that cylindrical rollers in "side" cam grooves did not bear uniformly against the groove, but were marked by work so as to show that the contact traveled from end to end of the roll, I assumed, without sufficient consideration, that a side cam groove cut by a mill did not have the shape of groove that it was supposed to have, owing to the compound motion of the cam blank while in process of cutting, and that because of this irregularity of cut no cam roller could be made to fit a so cut groove so that the roller would have at all points in the groove a full length line bearing on the side of the cam groove, but that the roller would touch the wall of the groove at one end or the other of the roller. To make my error correct some parts of the cam groove would have to be recut or cut twice in one passage of the mill, which upon after consideration seems impossible, although Oberlin Smith evidently has a doubt in this same direction as he says, May 11, 1893, p. 6, that the cam roll "could be made to fill the groove at all points at any rate upon a cam of comparatively large diameter"; this qualifying clause could have no foundation except in a suspicion on Mr. Smith's part of a recut in milling, which, as I say above, seems not possible.

I think I understood all of Mr. Oberlin Smith's article of March 2, and I will only say that I do not choose to write over my own name for print, and that I have used the one signature of "Easy Way" for something like twelve or fourteen years in the AMERICAN MACHINIST, and am always prepared with abundant practice for the foundation of any opinion I express. I do not think Mr. Smith read me correctly in the "Odd" paragraph; I said it was odd that Mr. Smith should assume the existence of a correct mean between two contradictory extremes, when it was clearly evident since the mean must act in one extreme and make an approach to the other, that such a correct mean was an absurdity, as it surely is. At one point in the cam groove the cone roller should be the frustum of a cone having its apex in the cam axis; at another point in the cam groove the roller should be some other

form, so Mr. Smith and myself agree; Mr. Smith says some unvarying form of coned roller can fill both of these differing requirements of form, and I say not so.

As to work located out of line, "springy," parts and "general tipsiness" as specified by Mr. Smith, I venture to assert that Mr. Smith never put up a cam and roll so that the roll had a full line contact with the working cam face at all points, and that he never made a fair approach to such a contact without careful hand-finishing of the cam face, and that such a contact when obtained on the erecting floor is not maintained in working except in cases where the roller is so supported as to be able to adjust itself to the cam face, either through a "springy" lever or otherwise, and that a decided approach to rigidity in cam roll supports is carefully avoided oftentimes by the designers of excellent work.

So far in this discussion it has been assumed by some (and denied by none) that the length of line of contact was a factor of cam roll durability. Such is not the case. We all of us see daily a cam roller loaded with seven or eight or nine tons, working on a 2 or 2½ inch face; it is true that this load of from 14,000 to 18,000 pounds on a locomotive driver is carried on springs, and that without the springs the wheel and rail would not live long; but the example proves that load, simply, does not require more cam roller face than we are led to give by the dimensions of friction resisting surface, the length and diameter of the cam roll stud.

Nor, again, does length of roller face prevent damage from a blow of the cam delivered to the cam roll. We seek constantly to avoid the blow, but with the "side" cam (which alone has given rise to all this discussion of the "cam roll") if the cam and roll are used without modifying elements the possibility of the blow cannot be avoided.

The roller cannot quite fill the groove, and hence must cross from one side of the groove to the other side, and a blow is the result of each crossing. In Fig. 1 if the roller *A* fills the groove then the cam effect transferred to the roller is exactly determined by the roller diameter and the divergence of the cam face from the idle line, and this divergence may be so delicately graduated as to move a great weight without shock; but in case of the "side" cam the roll cannot fill the groove, and hence as shown by the relatively progressive positions of the small roll *B*, *B*, *B*, Fig. 1, instead of a smooth change from rest to action the roll gets a blow from its abrupt meeting with the cam face at *C*. This blow belongs to the "side" cam and cannot be avoided; the roll must be smaller than groove will take; the roll must cross the groove and must meet the cam face of the groove, and hence a blow of some degree is inevitable. With a slow speed of revolution and a nearly filling roller this shock is small; with a high speed it is great and it is always a source of wear. This wear is modified unfavorably by a large roller. First, because of the mass of the roll, which makes the blow more effective, and second by the diminishing of the total time of acceleration which diminution is due to roll diameter. Any roll diameter shortens the time of accelerated motion effected by a given cam. Take the cam face *G*, *G*, *H*, *I*, Fig. 2, acting on a point; while the cam moves through *C D* the point is translated by an accelerated motion from rest to a certain velocity through *J K*; with the small roller *E*, in a cam time less by *A B* than *C D* the roller is moved from rest by an accelerated motion through the distance *J K* + *L M*, that is to say, a greater distance in less time, while with the larger roller *F*, *H*, *F*, the whole graduating and shock diminishing effect of the cam curve from *C* to *D* is entirely lost, the roller *F* receives a violent blow, and the parts connected therewith, if the construction is rigid, have no time of acceleration from rest to the speed due to the impact of the cam face on the roller—the actual speed being, of course, modified by the roller radius angle. This shows very clearly that Mr. Smith is wrong in advising a large roller for any work, especially for light work, which is very likely to be quick work, and hence demands all the time possible for acceleration, or change from rest to the quickest action. The roller should in all cases be as small as possible, and in practice for light rapid work it is always so made; when the roller stud cannot be lubricated so as to prevent cutting, then the stud diameter must be increased, even at the cost of increased roller diameter and decreased time of acceleration or increased diameter of cam, and not until the pin cannot be maintained need the roller diameter

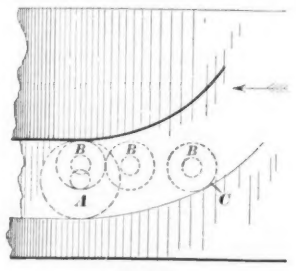


Fig. 1

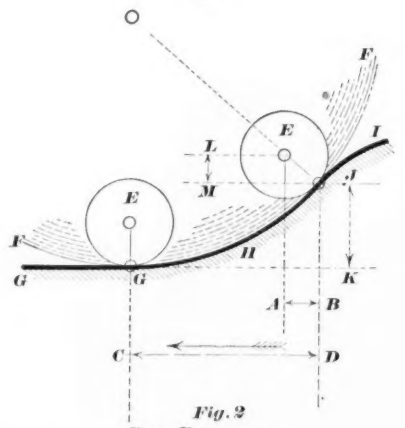


Fig. 2

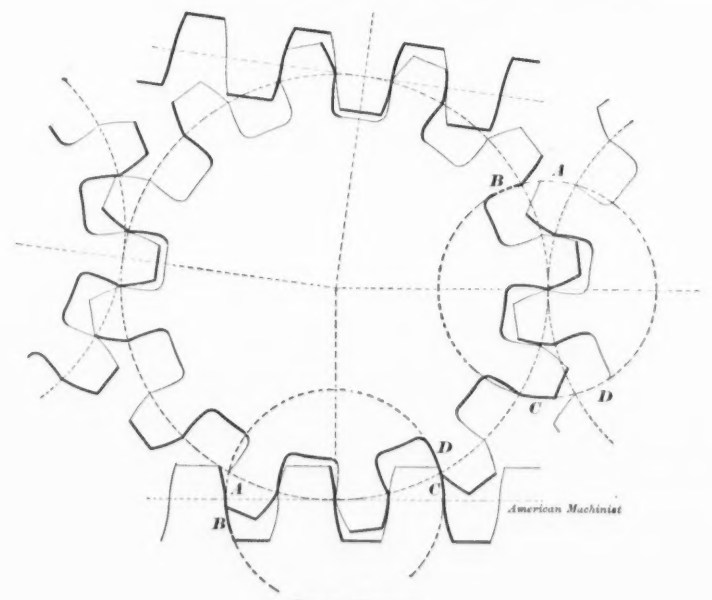
CAM ROLLERS.

be increased. Mr. Smith uses slow cams exclusively so far as I have knowledge of his work; if his practice included light quick actions he would never have advised a large cam roll. The cam rolls used for the best examples of quick cam actions seem absurdly small at first sight, but Fig. 2 shows conclusively that this small diameter is a necessity, not a mere matter of choice on the part of the designer. In fact the diameter of the cam roll, and no other dimension whatever, determines the possible velocity of a given cam action, where, as in most cases of quick cam actions, the only work to be done is the moving of the parts of the machine itself, the work of moving a thread or a sheet of paper affected by the action being too small to be taken into account.

At the conclusion of Mr. Smith's article, May 11, p. 7, he objects to a barrel-shaped roll as having insufficient resistance to crushing strain. The fact is that a barrel-shaped roll offers greater resistance to crushing than a straight-faced roll either cone or cylinder in form, when the curve of the face is as large as would be used in practice, because no straight-faced rolls bear with equal pressure on the cam face over the whole length of roller line, and hence the work is sometimes done on the unsupported inner corner of the cam roll, while the barrel roll always takes its work well within its length, and under anything approaching a crushing pressure the elasticity of the metal will give ample section to fill the office of the cam and roller as "compressive members," which elegant term has no working significance with any piece of cam work I ever saw. Cams and rollers fail from blows, not from pressure.

Vox populi vox Dei and the voice of the majority is unqualifiedly against the conical cam roll, which is always wrong unless it can be effectively used in adjusting to take up wear as asserted by Mr. Stedman. I know of no such arrangement, and would be pleased, for one, to have Mr. Stedman show it.

EASY WAY.



GEAR TEETH.

tions, also a rack and pinion of 12 teeth in different positions. This system is not adapted for cut gears, as the space in the smaller pinions is greater near the roots of the teeth than at the pitch circle. The angle which is formed by the intersection of the face and flank curves on the pitch circle of small pinions must not be rubbed down with sand-paper on the patterns, as it would decrease the thickness of the teeth on the pitch circle, and also destroy their true contour.

In reading over my former remarks in the

Gear Teeth.

Editor American Machinist:

When the paper was written about gears, and which appeared in your issue of April 27, it was not intended as a criticism on any method which Mr. Grant may employ in laying out gear teeth. He showed conclusively that gear teeth cannot be constructed to work in all cases according to the rule given in Haswell; but if Haswell had gone a step further and said that the flanks instead of being radial lines were also arcs of circles, it would then be found that there is no interference in the teeth. The objection to this would be the ridiculously weak pinion teeth.

In Mr. Grant's reply, June 1, there are some vague and elusive remarks about consulting a table when "rule of thumb" methods are employed, and that if ⅝ of the pitch is used in one case, some other fraction must be used in another case, but the reason for this statement is not given. The only table that need be consulted is the one for finding the pitch diameter; this is essential, as previously stated. When it is once decided whether the chord pitch or a fraction thereof shall be employed for describing the faces and flanks of the teeth, it must be adhered to, or there would be endless confusion when constructing numerous patterns. If the preference be given to the chord pitch as the radius, one point of the compasses will rest at the edge of a tooth on the pitch line or circle, and the other point of the compasses will describe a face and flank of adjacent teeth, as shown in the drawing at *A*, *B*, *C* and *D*, which represents two pinions of 12 teeth in different positions, also a rack and pinion of 12 teeth in different positions. This system is not adapted for cut gears, as the space in the smaller pinions is greater near the roots of the teeth than at the pitch circle. The angle which is formed by the intersection of the face and flank curves on the pitch circle of small pinions must not be rubbed down with sand-paper on the patterns, as it would decrease the thickness of the teeth on the pitch circle, and also destroy their true contour.

In reading over my former remarks in the AMERICAN MACHINIST of April 27, nothing has been said which is in anyway misleading, and the assertion: "That any gears with corresponding pitches will mesh without binding by describing the faces and flanks from points on the pitch line or circle, the radius employed for delineating the curves never being greater than the chordal pitch," can be proved by anybody who is capable of handling a pair of compasses. I never saw any gears with the teeth curves made with ⅝ pitch, the reason for using that fraction being formerly explained.

The gears spoken of as constructed had the curves struck with a radius exactly equal to the chordal pitch, and although the pinions are a little weak at the roots, this can be offset by using fillets and flanging the pinions, or half-flanging both gears and pinions when cast from patterns. The radius of the fillets is ⅛ of the chordal pitch. Whether gears made by this rule are as good as involute, epicycloid or other forms is another matter, and the writer has no wish to enter into any argument on this point. The chances are that every engineer will use that system which he prefers when having patterns constructed, until a definite system shall be decided upon.

Foreign to the subject, it may be mentioned that there are other points to be looked at besides the shape of the teeth, such as the proportions of the rim and arms. It is not the intention to impress anybody that this is a new way to lay out gear teeth, for it is mentioned in an article by J. T. H. in the April, 1873, number of the *Machinists' and Blacksmiths' Journal*, also hinted at in *Modern Practice of American Machinists and Engineers*, by Egbert P. Watson. There is also in the March number of a contemporary mechanical paper a letter describing this system.

It will be found that the greater the number of teeth, the better will be the result, notwithstanding Mr. Grant's words to the contrary.

In the *Pocket-book of Useful Formulæ and Memoranda*, by Molesworth, will be found the same rule as in Haswell's book, and this is very likely the fount from which Mr. Haswell obtained his rule, because in the late editions of Haswell there are many things copied from Molesworth, although, to do Mr. Haswell justice, he generally mentions the name of the author when giving information which has previously been in print. In any case, there is no mistaking Molesworth's diagram, it clearly showing that 1.25 of the pitch is the radius for describing the faces of the teeth, as it is not distorted like Haswell's diagram.

About five years ago a pinion with 9 teeth which transmitted 4 horse-power, and with teeth on this principle, was furnished on a machine, and to the best of my knowledge is still on duty. The secret, if secret there is, lays in concaving that portion of the pinion teeth which is inside the pitch circle.

CHARLES A. CALVERT.

Hours of Labor.

In our issue of March 30, we published the following:

INFORMATION WANTED AS TO REDUCTION OF HOURS OF LABOR.

Some readers of the AMERICAN MACHINIST are interested in knowing to what extent, if any, the regular hours of daily labor in machine shops have been reduced below ten. We would like to receive information on this point, either from proprietors or workmen connected with shops in which such reduction may have taken place, and will treat such information as confidential, if desired.

Having waited until this time and received only three direct replies, we are led to conclude that there is no great amount of interest in the subject. We give these replies as received:

Editor American Machinist:

My attention was called to your editorial in the issue of March 30th, on "Information Wanted as to Reduction of Hours of Labor."

I hardly know what information you

want. Would say that this company [Waltham Watch Tool Co.] some years ago, during a depression of business, commenced running nine hours per day, and continued it for several months, and being originally an eight-hour man, I thought I would consider the propriety of making nine hours permanent. I always held that the change from ten hours to a less number of hours should be made by gradual steps by half hours, *i. e.*, reducing from ten to nine and a half, working on that line for a year at least, possibly two years, until trade became adjusted to those conditions, then dropping to nine hours, running nine hours about three years, until trade had readjusted itself, and then possibly dropping to eight and a half; but it would be absolutely necessary that all classes of workmen in every State in the Union should work in unison with this idea. With this feeling for a less number of hours, I finally decided to adopt nine hours permanently, with the intention of gradually raising the hourly pay of the workmen until they received nearly as much as if working ten. This plan we have carried out, and the result is that we are not making quite as much money as we used to on the ten-hour basis, still we are fairly well satisfied with the result, and wish that our example could be followed in all machine shops. I have never seen any good reason why the building trades should work nine, and, perhaps, less hours, while machinists, a much higher grade of mechanics, should be compelled to work ten. A. WEBSTER.

Editor American Machinist:

In reply to your request in the AMERICAN MACHINIST of March 30, for information in regard to what extent the regular hours of daily labor in machine shops have been reduced below ten, I beg leave to inform you that out of over eighty shops in this city more than seven-eighths are working nine hours per day, the men receiving ten hours' pay.

M. J. GARNIER,
Sec'y Lodge No. 52 I. A. of M.
2164 Second avenue, Pittsburgh, Pa.

Editor American Machinist:

In West Virginia and Virginia it is ten hours per day; eight hours is not heard of in this part of the country, but I can give you the feeling of men who labor for their living, that the time will soon arrive when there will be a great break for eight hours per day. R.

Twenty-sixth Annual Convention of the American Railway Master Mechanics' Association.

The assembling of the master mechanics for their annual convention this year was at Lakewood, N. Y. The first session was on Monday morning, June 19, the sessions continuing through Monday, Tuesday and Wednesday. The meeting was not quite so fully attended as some of the previous meetings have been—notably the Saratoga meeting last year—but there were enough present to keep up a lively interest during the sessions, and a sufficient number (including those who are natural "objectors") who never let things get dull or listeners go to sleep under the somnolent influences of cool breezes and open windows. The statement that the number was not large should be taken in a comparative sense, and as applied to an association that gets together—members and friends—so large a number as the master mechanics. The members present, with their families and other friends, including supply men and master car builders who remained over from their meeting, just closed, made a large gathering in point of numbers. The great Fair doubtless attracted some members and others, owing to increased travel on their roads, did not find it convenient to leave.

The display of appliances usually seen on such occasions—most of them a heritage of the Master Car Builders' Association—was notably less than usual this year, the counter attraction of the Fair being undoubtedly felt in this direction.

Lakewood, with the distinguishing addition, "On Chautauqua Lake," to prevent it from being confounded with another famous Lakewood in another State, is, as the inhabitants never tire of telling you, situated on the highest bit of navigable water in the world, and, of course, ought to be cool, which it isn't always. It is, however, a very pleasant place, indeed, for a meeting of this kind.

The first call to order was at 9 o'clock, that is, 9 o'clock by construction, so to speak, but to be precise, 9:37, by President Hickey, who, after the usual formalities, delivered an address, which, from lack of space, we can no more than briefly notice.

THE LABOR QUESTION.

After a brief prelude, President Hickey referred to the "labor question" as follows:

I venture the assertion that every member of the association is confronted to a greater or lesser degree with the question of labor.

The situation of the labor problem to-day is not only causing more general uneasiness to the corporations in whose interest our labors are directed, but is the source of considerable anxiety to the essential principles underlying national property.

While it is true that members of this convention have to deal with but a moderate proportion of those who make up the rank and file of the laboring classes, it is also true that those comprising that proportion are to a large degree the guiding element. It will, therefore, be reasonable to assume that, when dealing in our official capacity with this question, we are either laying the foundation of peace and harmony with the working people, or sewing the seed of civil strife and disorder. It seems entirely proper that the members of this association both individually and collectively use all reasonable efforts towards harmonizing a situation of circumstances fraught with so much interest to all.

Public sentiment if not legislation guarantees equal rights to the masses. The march of civilization is onward and upward. All who are placed in authority should be considerate of the rights and welfare of their employes. A desire for betterment in the situation and surroundings of the working man is a natural and human aspiration. To those at least who have been raised and educated among us, these conditions seem to be an inherited right.

While business interests cannot possibly at all times comply with the demands and conditions of labor exponents, their requests should always be met and treated in a friendly spirit, and be considered and decided from the position of justice and fair play.

An arrogant manner and impatient consideration in dealing with our employes has too often been followed by unceasing annoyance, disquietude and unsatisfactory service, while honest recognition of reasonable requests has solved many a labor difficulty and prevented much lawless strife.

Tyrannical and arbitrary expressions of power have driven thousands of workmen to seek revenge in protective organizations, and we have many times condemned arbitrary acts of their champions when probably ourselves have laid the foundations.

No better plans to nullify the teachings of the labor demagogue can be adopted than to meet reasonable demands of the working men in the spirit of honesty, candor and fairness, and by advice and action to make them feel that labor well performed is appreciated, and that they will be protected against injustice (which is usually the result of hasty decision) and that faithfulness to duty means continued employment, promotion and protection to themselves and families.

LOCOMOTIVE CONSTRUCTION, MANAGEMENT AND MAINTENANCE.

Continuing, he called attention to the fact that about 50 per cent. of the operating expense of railroads was chargeable to fuel. To cut down the waste due to exhaust, various modifications had been made in the valve gear of simple engines, but the results had not been satisfactory. Much of the loss was due, not to the valve motion, but to the effect of cause which makes necessary a violent exhaust.

Boilers of larger capacity, he said, were required, boilers containing a greater amount of heating surface and possessing the highest facilities for proper combustion, permitting a larger percentage of the generated heat being imparted to the water and proportionately reducing the necessity of intensified blast.

He spoke of compounding as carrying on its face little doubt of success, but additional machinery enhanced the first cost and added to the cost of maintenance. Experience in practical tests had been such as to make the matter worthy of the highest consideration. He thought where the compound had been found to compare unfavorably in point of economy with the simple engine the dimensions of the former were not such as to adapt it to the work.

He had in mind many reports of comparative tests between simple and compound engines, showing enormous gains on the side of the latter. Where these conditions exist, it may be well to suspect that the excessive economy shown is only apparent, and may be due, not so much to the compound principle, as to the unprofitable performance of the simple engine, because of its improperly proportioned parts, or its incomplete condition.

Highly drawn service tests between simple and compound locomotives are not always commendable because the usual conditions under which the tests are conducted are often so widely different from those obtained in ordinary service, that results thus procured should hardly be regarded as conclusive.

The cost of repairs was referred to, particularly boiler repairs. One of the most important duties of the association was to prosecute investigation to the end of obtaining the most durable material for boiler construction.

There was a necessity for increased bearing surfaces. The bearing surfaces of crank-pins, eccentrics, links, guides, etc., could be enlarged from 30 to 40 per cent. over present practice with much benefit.

Eliminating straps, keys and bolts in connecting and parallel rods would result in much labor saving.

Speaking of education he said:

It seems to me to be the plain duty of all intelligent bodies to aid in the spread of enlightenment and education of the people, and I am of the opinion that no better plan can be adopted by the members of this or sister associations than to refuse to employ any who are not possessed of a reasonably fair education. It is a very noticeable fact that efficiency in the service is promoted in proportion to the education and intelligence of our employes.

At the conclusion of the president's address the secretary reported a total membership of 548, and the treasurer showed that the finances were in a satisfactory condition.

The committee on a Standard Method of Conducting Locomotive Tests, entered quite extensively into the requirements of such tests.

TESTS OF IRON AND STEEL.

Mr. Barnes presented the report of this committee, after which he said he disagreed with it in most respects, and should make a minority report. The majority report after going to some extent into the question and stating quite forcibly that the members of the committee were convinced that the present specifications requiring a certain chemical composition of the steel and a certain tensile strength and elongation were not sufficient to insure satisfactory results, so far as durability of fire-box steel is concerned, concluded as follows:

Your committee are decidedly of the opinion that certain requirements as to chemical composition, tensile strength and elongation, do not insure the best quality of steel for fire-box work. It is not certain that further inspection as to character of crystallization, etc., will do so, but there are good reasons for believing that such inspection would be of material benefit if made by an expert. The assertion has been made that no experts employed as such are to be found to-day. It should not be understood from this that it is thought that no such experts exist. On the contrary, it is believed that in nearly every shop there are a greater or less number of men who are quite capable of passing an adequate opinion on the relative merits of various sheets of steel from inspection of the fracture, who can say that one sheet is more liable to crack than another when used in a fire box of a boiler, in that one sheet will flange better than another. If, now, a man with such experience, a man who has worked steel and observed in his daily work on boilers how steel fails by corrosion and cracking, were to further extend his experience by systematically inspecting fractures made of all sheets that are used and are taken out of service, including good, bad and indifferent, he could not fail in the course of time in so educating his eye and judgment that his opinion would be almost infallible. If such a man had a preliminary experience in a steel-producing plant so as to familiarize himself with the processes of manufacture and materials used, it would undoubtedly do much to improve his efficiency. It is not to be supposed that any man will educate himself to make such an expert, and would be able to do so. The vast majority of men perform their daily work with their eyes shut to everything except just what is required to complete their daily task, but out of the sum total a few are always to be found who possess the necessary qualifications.

It is believed that in no way can a more decided advance in satisfactory boiler work be made than by proper learning and use of such an expert.

It is not intended that this system of inspection should dispense with present chemical and physical specifications; these have been made, or at least should have been made, from analyses and tests of steel that have given good results in actual service, but necessarily ignore much that is due to manipulation, and it is the importance of the points ignored on which your committee dwell.

It would be quite possible to get up very neat specifications, chemical and physical, of a loaf of bread: the crust must be so thick and of such a color, it must weigh so much per square inch, the pores must be of such a size and uniformly distributed; it must contain so much water, salt, gluten, starch, silica, phosphorus, etc., or if we analyzed to its ultimate composition, so much carbon, hydrogen, phosphorus, etc. This would all be strictly in accordance with the composition and qualities of a good piece of bread, but if an expert with fair experience in gustatory requirements, and we have many such, were employed, he would tell us more, and decide more definitely as to the qualities of that piece of bread, when he got a piece in his mouth, than by the most elaborate investigation on the line of the specifications outlined above. His decision would also be based on qualities which could not by any means be formulated in specifications.

Comparisons are dangerous, and the above is not intended as being a case parallel to the one under discussion; at the same time, it approaches very closely, in many respects, to being a true parallel; and if your committee succeed by this report in furthering a full and careful investigation of the merits of the expert system as outlined above, they will feel that they have done no small thing in advancing the art of manipulation of steel.

MINORITY REPORT.

Mr. Barnes in this report took exception to the majority report in about every particular. He believed that all that was necessary was that the material be up to proper specifications as to chemical and mechanical tests, then it would be found all right. It was, if not directly stated, made rather plain that he did not believe in the judgment of men who worked the steel and observed its behavior.

DISCUSSION.

In the discussion the opinion was rather strong in the direction that the final test of the steel must come from its behavior in working; that it might show chemically right, and right as to special tests required, and still be unsatisfactory. It was said that no specifications could be made that steel makers could not evade, and that the scrap pile would give more information than the laboratory. The discussion turned largely upon the effect of lamination on fire-box sheets, and the great danger arising therefrom, how it was possible to detect lamination, etc., when upon inquiry it was found that instances of failure of fire boxes from lamination were very rare, the trouble being in nearly every instance from cracking.

ADDRESS BY MR. S. FOX.

During the sessions this well-known English manufacturer addressed the association on the subject of the report—iron and steel He spoke substantially as follows:

Gentlemen, I consider that you have done me a great honor in asking me to say a few words on the all-important question of the material of which our boilers are built. I would, in the first place, ask you to consider that I do not come here as a teacher. I do not come to teach any one his business, but I happened to be in this country for the last two weeks and have met a number of

(*Continued on page 9.*)

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Headquarters at the Fair.

During the continuance of the Chicago Exposition the AMERICAN MACHINIST will have its headquarters in the space allotted to the Mechanical Press in Machinery Hall. The exact location is Section No. 27, Column K 37. Word can be left with the attendant there by any one who is desirous of meeting a representative of this paper, who may at the time be engaged elsewhere on the grounds.

A Plea for Small Things.

We are never done hearing of the effect of compounding on the economy of the modern steam engine. It is right and quite natural that we should hear a good deal about it for the saving it has brought about is a very important one. This has been so completely settled against much opposition as to be no longer in question, and the moral right to waste the fuel which its employment will save might be brought up as against those who failed to avail themselves of its advantages, at least when they can do so at a material saving in dollars and cents, for the world's supply of coal will last longer if it is used economically than if it is wasted. The moral side of the question, however, is not pointed out in the expectation that it will have weight. What people are to do without coal some hundreds—or thousands—of years hence does not trouble the present generation to any great extent. It is the quantity they have to pay for just now that induces steam users to look with favor on compounding, and it is the magnitude of the saving that impels them to look at it twice, and to adopt it; but the attention it receives is likely to—in fact does—prevent attention to other comparatively small details of modern steam engineering that have, not singly but in the aggregate, shown how a saving equal to that of compounding may be effected.

The reason why so much is said about compounding and so little attention given to minor improvements is because the saving by compounding appears as a gross sum, so to speak, while to show an equivalent saving in the other case is a question of items. Several details that appear individually small must be considered. That too little used rule of addition must be brought forward and employed. A saving of twenty per cent.—if that is a fair estimate of the saving by compounding—looks large. It is large; a good round figure all by itself. But a saving of five per cent. or less looks small to the average steam user. Several items must be added together to equal twenty per cent. It is almost infinitely easier to get steam users to consider twenty as a single quantity than it is as made up of a half dozen or a dozen quantities Yet there is little doubt that the sum of the small things—small modern improvements in an economical sense in steam engineering—more than equals any single great improvement, as compounding, which is also comparatively modern in its application.

You cannot talk about a great saving in connection with a damper regulator, for example, but in the every-day operation of a steam plant a good one will save coal. It would be impossible to demonstrate this by an expert test because a human damper regulator is as good as any, but it costs a good deal more, and it is practicable only in expert tests to have such a luxury. In the modern steam engine the requirement—if economy is considered—is constant steam pressure. The engine runs better for this, and steam is saved by it. The damper regulator will add its modest item towards making up the twenty per cent. saving.

The steam engine governor has been brought to a state of comparative perfection within a few years. It will bring about a desired result at less cost than its ancient predecessor. It is one of the small things that helps in getting good power economically.

The steam gauge, of comparatively modern use, is a better appliance for noting pressures than the safety valve that preceded it for that purpose, or rather which in addition to its other purpose afforded a means of guessing at pressures. Fortunately present requirements are such that the steam gauge is practically indispensable, but its use in the interest of economy is not lessened. The question as between the use of a good one and a poor one is largely, but not entirely, a question of safety.

Improved means of lubricating the wearing parts of steam engines means less useless and more useful work from a given quantity of fuel, and the modern balanced valve is a means to the same end.

The getting of the steam engine indicator—an adjunct of the engine room—into condition to be successfully used by the every-day engineer must be credited as amongst the small things that save steam. Its common use assists the engineer in keeping his engine in the best possible condition to serve its purpose as an economical machine; helps to cut down expenses.

There is no intention of going through or entering very largely into the list of modern minor steam engine appliances, the total of whose savings is important. It would be impossible to do so within reasonable limits. The idea is only to indicate a direction for profitable thought. It would, however, be unfair to leave out the feed-water heater of the present, so improved as to make its application an insignificant matter. Still, perhaps, it is hardly fair to use it as an example of small things effecting a saving, as it does in many instances, so important. It is a well-known fact that there are thousands of steam engines running in all parts of the country, literally throwing away from ten to twelve per cent. of all the fuel fed to the boilers from failure to use this simple device that has been so well perfected for the purpose of saving it.

Altogether, if this subject were gone into exhaustively, if the small things that have come up within a few years in connection with the use of steam and the steam engine were put together as to their results on economy the aggregate would be surprisingly large. They should, while securing by all means the advantage of compounding wherever it is practicable to do so, be given greater consideration than they receive. By all means give the small things their opportunities; the things that count in the regular every day operation of the steam plant; that count with compounding or without it. Successful steam engineering is mainly made up of small things.

Chicago Water.

While there has been much discussion *pro* and *con* respecting the purity or impurity of Chicago's water supply, there is, we think, sufficient ground for fear that it is not what it ought to be to make it advisable for those who visit there to be very careful about it, and, in fact, to avoid it until there is more abundant proof that it is pure, and less proof that it is impure. We find in the Chicago *Tribune*, of the 20th ult., for instance, an extract from an address by Dr. Ernest Hart, a London expert on sanitary matters, delivered before the Chicago Medical Society, according to which the water that is being supplied there for drinking purposes is badly contaminated with sewage, the doctor stating to begin with that analysis is not needed to demonstrate this as a mere inspection of the water of the lake, such as can be made by taking a rowboat and going out toward the intakes, is sufficient. He stated that the sterilized water furnished on the Fair grounds had been analyzed from day to day and had been found to be badly contaminated, there being in one instance 600 bacteria to the cubic centimeter, and another day 1,200 to the centimeter, thus showing not only gross impurity but a fluctuation in degree of impurity that suggests the possibility of almost anything. He stated unequivocally that the prevalence of typhoid fever in Chicago was indicative of danger of cholera, and that both were threatened by the impure water supply.

So far as the sterilized water furnished by the Fair authorities is concerned, and which is labeled as such with the request not to waste it or use it except for drinking purposes, while it was no doubt sterilized when the tanks were first put into the grounds, and while there was something of a "scare" about the water, it has lately not been sterilized at all, but is Chicago city water with all that goes with it, as we happen to know, and that is the reason the doctor found this so-called sterilized water to be so full of bacteria. Filters are being put in which it is thought will purify the water; whether they do or not will be determined when they are in service, and some of the water that comes through them is occasionally tested. For our part we confess to a preference for water that has not been contaminated, and that needs neither sterilization nor filtering; this Chicago should have seen to securing long ago. The Waukesha water that is furnished on the grounds at one cent a glass is probably pure; but it is so warm as to be very unpalatable, and to many persons, undrinkable, the only resource then being bottled mineral waters which add considerably to the expense of visiting the Fair. It is to be regretted that this is so, and we dislike to have to criticise on this point, but we believe it is a matter regarding which there should be no attempt at concealment. People are entitled to know the truth concerning it.

A fireman named Peebles, employed on the Kansas City, St. Joseph & Council Bluffs road, is reported to have adopted a very effective method of discouraging a train robber, who with his confederates had brought the train to a stop and was crawling over the coal in the tank toward the cab with a revolver in his hand. Fireman Peebles happened to be wetting down the coal with a hose, and as soon as he saw the figure of the crawling man in the darkness he turned the hose upon him. This drew from the robber a wild revolver shot and created sufficient diversion to enable both the fireman and engineer to get possession of revolvers which they had in the cab, and with which they continued the work of demoralization begun with hose. That fireman evidently possesses one of the most valuable and necessary traits of a good engineer—he knows what to do in an emergency, and with the means at hand.

Literary Notes.

ELECTRICAL MEASUREMENTS AND OTHER ADVANCED PRIMERS OF ELECTRICITY. By Edwin J. Houston, A. M. Professor of Natural Philosophy and Physical Geography in the Central High School of Philadelphia; Professor of Physics in the Franklin Institute of Pennsylvania; Electrician of the International Electrical Exhibition, etc.

In the first three chapters (which the author calls primers) of this work, the principles upon which the measurement of electric currents, electromotive forces and resistances are based, are explained in a manner easily understood, and instructive to the student and non technical reader. The apparatus used for these measurements are also described. Although the author does not pretend to teach the operations in determining these measurements, the book contains useful and valuable information for all desirous of progressing in their study of electricity. Two chapters are devoted to voltaic and thermo-electric cells and other sources of electricity. The remaining chapters treating on arc and incandescent electric lighting dynamo electric machines, electric transmission of power, etc., will be particularly appreciated by all intelligent readers who desire to obtain a correct knowledge of the applications of electricity. The book is published by the W. J. Johnston Company, Limited, 41 Park Row (Times Building), New York. Price, $1.00.

MINERAL RESOURCES OF THE UNITED STATES, CALENDAR YEAR 1891. By David T. Day, Chief of Division of Mining Statistics and Technology. Department of the Interior, United States Geological Survey. J. W. Powell, Director.

This volume is the eighth of a series which began in 1882. It contains a complete statement of the mineral products during the year 1891. The volume also contains much information relating to new

discoveries of mineral deposits, new uses for these products, and improved technical processes by which minerals have been made more available, the yield increased, etc.

Those who are in any way interested in the mineral resources and wealth of this country, and the progress made in the production of minerals, will find in this work information thoroughly reliable, interesting and valuable.

The price of this volume is 50 cents. Remittances should be made by postal note (not stamps) and should be addressed to the Director United States Geological Survey, Washington, D. C. Previous volumes of the series can be procured in the same way; the price of each of the previous volumes is 50 cents each, excepting volume for 1883–84, which is 60 cents, and volume for 1885, which is 40 cents.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(317) M., Mt. Carmel, Ill., asks: Where can I obtain castings for a gas engine of about 2 horse-power? *A.*—You may obtain them from A. C. Manning & Co., 18 Vesey street, New York. 2. What is good to paint a boiler with? *A.*—Either asbestos paint or graphite paint. 3. How are balls turned true? *A.*—See our issue of September 29, 1888.

(318) J. D., Philadelphia, Pa., asks: What size of boat and propeller should I use for a small engine with cylinder 2 inches diameter and 3 inches stroke? Speed of engine is to be 400 revolutions per minute, and working with a boiler pressure of 100 pounds. Also what speed do you think I could obtain? *A.*—Length of boat, 18 feet; breadth, 4 feet 6 inches; depth, 2 feet; diameter of propeller, 12 inches; pitch, 21 inches. Speed of boat about six miles per hour

(319) F. M. N, Steelton, Pa., writes: I am engaged in running milling saws for sawing cold steel rails, etc. Please give me the best plan known to temper them and keep them from buckling at the same time. I have tried several plans but they do not give satisfaction. *A.*—We made inquiries at a saw works in regard to tempering this kind of saws and were informed that saws for iron and steel are hardened in the same way that saws for wood are hardened, the only difference being in drawing the temper, which for wood saws is brought down to a blue, while steel saws are frequently left as they come out of the oil bath. Saws for wood are tempered in the following manner: The saw is first heated to a red, then plunged into a bath of oil, rosin and beeswax, the proportions of which we could not learn. For drawing the temper they are placed between heated plates and then again dipped when the proper color is reached.

(320) J. M. M., Manistee, Mich., writes: Please inform me how to find the nominal horse-power of an engine whose cylinder is 8 inches diameter, and 12 inches stroke; running at the rate of 150 revolutions per minute, boiler pressure 45 pounds. What is the difference between the nominal and indicated horse-power? *A.*—The term nominal horse-power is obsolete, and has no meaning; see answer to Question 44, in our issue of February 2, current volume. For finding the indicated horse-power of an engine, we will have to refer you to answer to Question 156 in our issue of March 30, current volume, in which an example is worked out. 2. Is it necessary to have a knowledge of geometry and algebra to become a marine engineer? *A.*—The complicated machinery now used on ocean steamers requires men of education to take charge of it, and we do not see how they can obtain a thorough education to fit themselves for their positions without a knowledge of geometry and algebra, or at least a knowledge of the elements of these sciences.

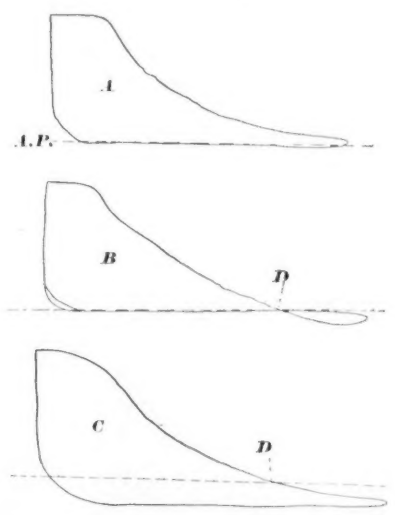
(321) J. F. B., Oxanna, Ala., writes: A shopmate of mine claims he saw a cylinder 94 inches diameter, for compressing cotton, lying horizontally on a car, and it measured ⅛ inch smaller one way than the other. He claims all large cylinders will be smaller one way than the other when lying in a horizontal position. I cannot believe this. Cylinders may be a little smaller one way than the other, but I believe this to be due to bad workmanship. What do you think about it? *A.*—All cylinders of large diameter will sag more or less when laid in a horizontal position. The amount of sag will depend not on the diameter only, but also on the thickness and depth of its flanges, and the manner of stiffening the cylinder walls by brackets, etc. We should always take the precaution, when a large cylinder is to be laid in a horizontal position, without its heads being bolted to it, to put suitable props in the bore so as to prevent injury to the cylinder. You are wrong in assuming that the difference between the vertical and horizontal diameter of a cylinder is due in all cases to bad workmanship.

(322) J. B. R., Mobile, Ala., writes: Please give me what information you can regarding the use of oil for marine purposes in small boats, as I have one and wish to make her an oil burner as fuel is very difficult to get where I am Any information you can give me as to the best burners to use will be appreciated. *A.*—There are a number of burners on the market, a very good one is illustrated in our issue of June 16, 1888. The successful combustion of oil appears to be in the setting of the burner and the arrangement of the furnace. The furnace should contain plenty of fire-brick surface, which, by becoming heated, will insure the complete combustion of the oil before the vapor or gases come in contact with the boiler. The burner should be set so that the oil vapor will be directed against the brickwork and not against the boiler. Brick flues so placed as to become highly heated should be provided for supplying hot air to the burners. It will be seen that these requirements can be met by additions to the ordinary setting, without disturbing it to such an extent as to render it difficult to return to the use of coal if it should be desirable at any time.

(323) S. W. T., ——, R. I., writes: Please answer the following questions, and give rules for their solution. I have a worm of 5 pitch running with a worm gear of 48 teeth. The worm makes 175 revolutions per minute, how many revolutions will the worm gear make? *A.*—If the worm is single threaded, the gear will make $\frac{1}{48}$ of a turn for one revolution of the worm, hence during the time the worm makes 175 revolutions, the gear will make $\frac{175}{48} = 3.645+$ revolutions. 2. On the worm gear shaft there is a pinion of 18 teeth meshing with a wheel of 34 teeth; the latter drives a rack; how fast will the large gear run, and how many feet will the rack travel per minute? *A.*—The large wheel will make $\frac{18}{34} \times 3.645 = 1.929$ turns per minute. But this wheel is an intermediate gear and will not have any influence on the speed of the rack; as far as speed is concerned, the latter might just as well be made to mesh with the pinion of 18 teeth. This pinion makes 3.645 revolutions per minute, and will move the rack through a space equal to $18 \times 3.645 \times$ pitch $= 65.61$ times the pitch. 3. Please give rule for proportioning cone pulleys. *A.*—See our issue of December 1, 1888.

(324) M. K., ———, Pa., writes: Kindly give me a rule for finding the thickness of iron or steel cylindrical tanks or stand pipes 35 feet diameter, and 75 feet high. The plates are much heavier at the bottom than at the top, but how much? *A.*—The pressure per square inch tending to burst the bottom of the tank is found by multiplying the height of the tank by the weight of a column of water 1 foot high and 1 inch square; the weight of this column is .434 of a pound. Hence we have, $75 \times .434 = 32.55$ pounds pressure per square inch at the bottom of the tank. Multiplying this pressure by the radius in inches of the tank we obtain the tensile stress per square inch which the metal has to resist. Thus, $32.55 \times 210 = 6{,}835.5$ pounds for the stress per square inch of metal. To obtain the thickness of the sheet to resist this stress per square inch, divide the latter by a constant, whose value depends on the quality of material and the kind of riveted joint. For ordinary iron single riveted we may use 5,100; for iron double riveted, 6,300; for steel single riveted, 7,300; and for steel double riveted, 9,100. Hence for iron single riveted, the thickness at the bottom of the tank should be $\frac{6{,}835.5}{5{,}100} = 1.34$ inches, say, $1\frac{7}{16}$ inches. The upper end of the tank is subjected practically to no pressure to burst it, and therefore the thickness of iron at the top should be simply such as to allow calking for obtaining water-tight joints; a thickness of ¼ inch will answer the purpose.

(325) J. S. H., Boston, Mass., writes: An argument has arisen on the subject of expansion in simple engines. My opponent holds that any expansion below the line of atmospheric pressure, whether in condensing or non-condensing engines, is bad engineering, and that the part of the stroke after the expansion has fallen below the line of atmospheric pressure represents a minus quantity, and must be subtracted from the other part of the diagram. To make the matter a little clearer, the following diagrams are given. Kindly put a little light on the subject, and oblige. About *A* we do not dispute, and on *B* we agree that the stroke from *D* represents a drag on the fly-wheel. But I disagree with him when he says that the same conditions obtain in the case of *C*. *A.*—The card *C* represents one taken from a condensing engine, and the



area bounded by the lines of the diagram represents the amount of work done by the steam. That portion of the area of the card which lies below the atmospheric line must not be subtracted from the area above the atmospheric line. In a condensing engine the back pressure in the cylinder is reduced to below the atmospheric pressure, and, therefore, the line of counter-pressure or back pressure line on the card must be below the atmospheric line, and shows, as it should do, that in condensing engines the resistance to the forward progress of the piston is decreased. But in a case in which the pressure falls by expansion below the line of counter-pressure, as at *D* in case *B*, it is plain that the pressure on the right of *D*, urging the piston forward, is less than that resisting its progress. To get the mean effective pressure in such an instance, it is evident that the resistance indicated by the part of the diagram on the right of *D* must be deducted from the forward pressure indicated by the part on the left of *D*.

(326) S. G., Lambert, Minn., writes: I am studying "Fourteen Weeks in Physics," by J. D. Steele. In hydrostatics I find the following statements, which I contend are wrong, and would have you enlighten me on this subject: 1. "A strong cask or barrel fitted with a small pipe 30 or 40 feet long, and perpendicular to the top of barrel, if filled with water (both barrel and pipe) will be burst asunder." *A.*—We see nothing wrong in this statement, excepting that the term "strong" is in this case very indefinite. Under the conditions given, the barrel and pipe may or may not burst; the result depends on their strength. 2. "The pressure is as great as if the tube were of the same diameter as the barrel." *A.*—We see nothing wrong in this statement. 3. And further in explanation of the foregoing, the author says: "Suppose the pipe above referred to has an area of $\frac{1}{10}$ square inch, and to hold ½ pound of water the pressure on each $\frac{1}{10}$ of a square inch of the interior of the barrel will be ½ pound, or 2,880 pounds on each square foot, a pressure no common barrel could sustain." *A.*—This is correct. A pressure of ½ pound on $\frac{1}{10}$ of a square inch is equivalent to a pressure of 20 pounds per square inch, or $144 \times 20 = 2{,}880$ pounds per square foot. 4. The same author also claims that, "If a vessel full of water closed on all sides has two cylindrical openings, one of them a hundred times larger in area than the other, and if each of the cylinders be supplied with a piston which fits exactly, a man pushing the small piston will exert a force which will balance that of 100 men pushing the large one." I also contend this to be wrong. *A.*—Nothing wrong in this statement; of course it should be understood that each man exerts an equal amount of force. All these statements are based on the *principle of equal pressures*, which states: *If a fluid is in equilibrium under the action of any forces whatever, each particle of the mass is equally pressed in all directions;* for, if any particle were more strongly pressed in one direction than in the others, it would yield in that direction, and motion would ensue, which is contrary to the hypothesis. It follows, from the principle of equal pressures, that if any point of a fluid in equilibrium be pressed by any force, that pressure will be transmitted without any change of intensity to every other point of the fluid mass. This principle can be proved experimentally. 5. Please let me know if the above-mentioned book is reliable aside of the above. *A.*—We have not studied this particular book, but from the quotations given, we should judge it to be reliable.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

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"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Twenty-sixth Annual Convention of the American Railway Master Mechanics' Association.

(*Continued from page 7.*)

gentlemen interested in the question of fire-box plate.

Fire-box plate, for the purposes of fire-boxes at sea, I have manufactured for a long number of years. I think if I were to say to you that I have turned out within the last fourteen years at least one hundred thousand tons of fire-box plate I should be within the mark. You know that a man who has done a large amount of work must have made a large number of blunders, and it is out of the blunders that he may find what may be considered the best way of keeping the straight path. What we consider in fire-box plate making, first of all, is to select very pure materials. That is to say, we will take pig-iron which contains in nature the smallest amount of phosphorus. We do not mind very much the amount of silicon nor the amount of carbon. We consider that it is necessary to know exactly the composition of the fuel that we use in every part of the work so that the gas from the fuel shall have the same value in purity as the pig-iron that we have already started to work with. Having these together and both clear from these very serious enemies—sulphur and phosphorus—we may then go to work and expect to obtain a fair, reasonable result. It is important also that the linings of the fur-

nace, such as the sand and ganister that you use, and also the bricks of which it is built, shall be as pure as the gas and pig-iron. Therefore when the action is through there is no doubt that after such a start you will get as a result, a pure plate. For fire-box purposes it should have about .11% of carbon. You may put from .50 to .55% of ferromanganese into it, but you should get your sulphur and phosphorus down to as low as .04 to .05%. If you do that you will have a material which, if properly manipulated from the ingot down to the shorn plate, will do almost anything as regards standing fire and every manipulation involved in turning it into first-class boilers. I believe that in some factories in this country it is not thought necessary to put any work on the ingot. We hold a different opinion. We prefer for the best class of work to hammer the ingot, reducing it from about a 15 inch thick ingot to about five inches. That ingot is hammered on the flat and on the edge and the ends are cut off. It is necessary to exercise care in reheating such a slab, because we all know that we are troubled at times with lamination in the plate. That has been clearly proved over and over again to be caused by the overlapping of one side of the plate over the other. Men who are rushing their work will bring out their slabs not so well heated on one side as on the other, and when such a slab enters your rolls the soft side will run ahead and draw farther than the hard side, and the hard side is, as it were, rolled partially into the soft slab. This may not show itself, even when the plate is short, when it has been annealed, but still it will show itself in working some day. It will show itself when it comes to deal with the expansion and contraction due to its work in the boiler. Now the question for the user should be to buy only on the conditions of certain mechanical and chemical tests. If the committee were to look fairly into the different tests set forth either in France, or in Germany, or in England, they would find that there is a steadfast growing of the practice of standard tests, especially for fire-box work. The Board of Trade, the Admiralty of England, and many other associations, such as Lloyds and the Bureau Veritas, set down that a piece of material shall be cut from the plate which shall, in ten inches of length, elongate, in testing, from 20 to 25 per cent. The British Admiralty figure is 25 per cent.; so is the Russian Admiralty, and so is the French Admiralty. But the Board of Trade go down as low as 20 per cent. In addition to this the Admiralty makes a standard of tensile strength. They say it shall be not more than 25 tons to the square inch, and they usually say it shall not be less than 24. Now if you are bound within the range of a ton you have got to have your chemical composition uniform all through all the plates you make, and if you get an elongation such as I have mentioned at 23 to 25 per cent. that will be a material that will do very good work. We have found by experience that there should be a little difference in the amount of carbon according to the thickness of the plate that you are making. If you are starting with .11% carbon for a quarter-inch plate, and you are going to make half-inch plates which shall bear the 25 tons and not less than 24 tons tensile test, and with the same elongation of 25 or 20 per cent., you must put a little more carbon into the half-inch plate than you put into the quarter-inch plate, and so on. Otherwise you will not get the same tensile strength, because your material is made more dense in rolling down to a quarter-inch plate than to a half-inch or three-quarter-inch plate. These features have led to pretty fair success on our side. I am sure that if the users of plate in this country were to lay down a standard of purity and strength and elongation of plate this would be the very first thing to do in order to get that uniformity in fire-box plates which is so much required. Of course a great many plates would have to be thrown out, but there is nothing like having a lot of material thrown out to make a man find out what is the right thing for him to do. We employ a method of determining the amount of carbon which is known as the color test. We take a known weight of a chemically pure iron or a known weight of steel with a known quantity of carbon. That known weight of pure iron is dissolved in acid and a known weight of water mixed with it, which produces a rather crimson colored liquid. We take our supposed pure iron from the furnace and we weigh the same quantity and dissolve it with the same quantity of acid as the other, and then fill up two test tubes that are graduated with such a quantity of water as will bring both the liquids to the same shade of color, looking at them upon a sheet of white paper. The result is that when you read off the difference in the water on the scale of the two tubes you know the difference in the carbon between one and the other. One is considered to be without carbon entirely and the other may have a little in it. That process can be carried through in ten minutes. If you want to know what carbon you have in a piece of finished material, you treat it in the same way. There is no doubt that you will always get the best results by taking your test pieces lengthwise from the sheet, but we do not want that. We want the worst condition of the plate and we get that by taking the test piece off crosswise. We always adopt that system and it is a satisfactory one, inasmuch as when you have got your standard of density and elongation on a piece cut crosswise you are much more sure to be right lengthwise.

At the conclusion of Mr. Fox's remarks, which were received with every manifestation of interest, he was asked the selling price of such material, also the effect of a still greater reduction of phosphorus and sulphur, to which he replied:

The material that I make is sold for about nine pounds per ton of 2,240 pounds. Of course, you cannot produce the same class of material at the same price in this country. The result of reducing phosphorus and sulphur say to .02 and 025 or .030% respectively would be better results as regards cracking or starring or anything due to the application of the heat on one side and water on the other. But when you get down to completely pure iron you lose the dignity of the material to an extent that allows other difficulties to creep in, such as grooving and pitting of the plate due to various changes of water. These constituents in small quantity, where they do not interfere with the ductility of the material are, in my opinion, a considerable safeguard against what occurs when a very pure iron is placed in contact with water that is being made into steam, such as pitting and grooving. We have been troubled with that with some classes of water in marine boilers. But we can get over that by introducing zinc into the steam space. The zinc, by degrees, deposits itself over the surface of the plates, and the result is a whitish coloring which seems to protect the plate perfectly from these difficulties of grooving and pitting.

(To be Continued.)

Things to See at the Fair.*

FRIEND HEMENWAY: I used the first draft of my letter to you about the Exposition as a prelude to a talk given our men as to "what there was to see, and how to see it at the World's Fair," and it's simply incomprehensible how they and everybody seem to misinterpret my statements. The daily papers got hold of it, and ignored every thing I said in praise of the buildings; ignored the fact that I was comparing the inside with the Paris Exhibition buildings, and simply reported that I said "the buildings were simply barns." Even that injustice I could easily endure if they did not misinterpret my motive. Why is it that people do not see that if we are going to excel in the world we must know what others do, and if they profit by a knowledge of what we do better than they, we must profit by their successes to keep pace? To look at the matter otherwise is to assume that we know it all, and others are worse than fools, for the wisest man can learn even of a fool sometimes.

While I had said all I thought I wanted to say about the buildings, there is this, the architects of most of the large buildings have made the one mistake there was no excuse for, and that is repeating the Paris failure, of using skylights which convert the buildings into hot-houses. It would be better for such buildings to set the sash plumb and hang them on vertical pivots, with ropes to turn the edge to the sun.

Properly engineered, such buildings might be made as comfortable as one need ask to have them.

You will remember in my letter to Bullock, published in the *Inter-Ocean*, I suggested the use of the cantilever principle. This has been adopted in the Mining Building, but just wrong, using it on a slope with skylights instead of a flat with vertical sash, which was the very point aimed at. The Transportation Building strikes me in one respect as the best, simply perhaps because there has been the least expended for show, and that show is in colors with the windows upright. The cost was only about a dollar a square foot, whereas the other buildings average nearly 50 per cent. higher, some being quite double that.

Perhaps my taking a notion to the Transportation Building is from my admiration for Adler, one of the architects, the only man I ever happened to meet with who builds his foundation with brains and solid material.

I am glad I gave up trying to write for the AMERICAN MACHINIST, as I can now spin it off off-hand, and put in the side play without fear and trembling. But as to the things to see. Entering at the 64th street entrance, which I fancy is the *mainest* of them all, the first thing on the right is a long cold storage building, built by the Hercules Iron Works, of Aurora, Ill., as I understand it. It is, of course, where the ice and other cold things are kept on tap, and where one interested in such things can learn the ins and outs of it, and the merits of the builders' products.

Next and on each side are fair-sized, rather tasty buildings, the one on the right the Pennsylvania Railroad Co.'s exhibit. Outside may be seen the first of their locomotives, and the girder cars used to bring the large guns from Washington, and the Krupp gun from Sparrow Point, with wood models representing the real guns in place. The point I noticed was that the wheels were wrought-iron, the sort we have been ridiculing ever since I knew anything about railroading. I have always thought I would live to see that practice come in this country, but it is now possible steel castings for longevity will come first.

In talking with Angus Sinclair, editor of *Locomotive Engineering*, I find he thinks as I do that for the Exhibition Flyer the single large wheel English locomotive is the machine that will eventually be found the proper one. The trouble with single driver is starting, but there are but four starts to make.

Opposite the Pennsylvania Building is a building similar in size for the Vanderbilt system, where was being placed on exhibition copies of the first and examples of the present central trains complete. Just what is to be shown in the buildings themselves did not appear, but I understand among other things Arthur Yates' great photo of the Empire Express, claimed to be the largest photo ever made.

In the Transportation Building adjoining on the left begins the show in magnitude, and for one interested in the history, the old track experiments from the strap rail up through the cut stone ties, the U, the split T, and all sorts of experimental devices are fully as completely represented as the growth of the locomotives and cars.

If you wish to see what sort of machines the foreigners use to transport people and freight, this is certainly the best opportunity you are likely to have this side of the Atlantic, and whether one looks to laugh or to learn, he can find plenty of material for either. Whether one likes our ways or other ways, many good things can be seen and plenty of good work done by all nations.

While I advise going early to the Exposition, there is one point favoring a delay that I had not thought to mention. There is column upon column of information being published on what there is to see, so if you who contemplate going later will note the things mentioned as particularly fine or interesting, you can at a much less expenditure of energy find the things you wish to see as you go along.

Locomotives and cars are in the Transportation Annex. The big things, such as the full size model of the great Schneider steam hammer from Bethlehem you will see without telling, but such sights as the fine carriages from this and other countries, and the Cunard models of their ships from the "Britannic" of 1840 to the latest "Campania," are worth your while to look for down the north aisle.

Leaving the Transportation Building by the main entrance in the center of the front, you want to turn and look at the Golden Gate and note the grand effect produced by unique and rather simple means.

You will now be in position to get one of the great sights of the building show—twenty or more large buildings in sight surrounding the wooded island and lagoons; the view is grand.

Entering the Mining Building, three trips up and down its whole length of 700 feet through the three aisles will give a perfect general idea, and enough unless one is specially interested to satisfy most of the visitors. For the mechanic, there is mining machinery, to a large extent the product of the forge and rolling-mills, and raw material worked into endless variety of forms, from the ore to the silver statue. As to the supremacy of American art in this line, I think "Ada" will be sorry she was ever born a beauty. Look at the masterpiece of American work, and the every-day sort in the French and Italian sections, or say Dickens and "Little Nell" in the Fine Art Building.

There is a group of these German iron or steel tubes made from the solid rod, and a wonderful display of wrought-iron work from Stumm, of Austria. This single exhibit, 125 feet long by 65 feet high, costing $100,000, is wonderful when you stop to notice that it is the product of the rolling-mill, from the ornamental figures around the signs to the largest pieces of pipe three feet in diameter, and everything split open and polished, so you can see the perfection or imperfection of the product. The more you look the more wonderful you will see it is. Things we see in cast iron are here produced in wrought-iron and steel.

The American companion piece, the Cambria Iron Co., may be more wonderful, but is not so large, neither is the Bethlehem shown in the Transportation Building; and the Stumm is from the far-away, old fogy Austria. Look at the obelisks of I-beams with mitered corners and wonder as to how it was done. There are other wonders, too, throughout the building, American as well as foreign, and if I don't mention our own as much as the others, it's because you know as much about our own as I do.

JOHN E. SWEET.

* From a private letter, by permission.

A Mechanical Boiler Cleaner.

The Mechanical Boiler Cleaner Co., Montclair, N. J., is putting on the market a mechanical boiler cleaner which consists of a pipe, one end of which is stopped, 2½ to 3 inches in diameter, entering one head (of a horizontal boiler) and extending nearly to the other head, near the bottom of the shell. A series of holes are drilled in this pipe, beginning at one end and advancing spirally to the other. In these holes metallic nipples, with a small openings, are inserted. Connected with this pipe at the head a pipe in which is placed a quick-opening valve extends to the sewer or other convenient place. It is claimed that by using this occasionally, the intervals depending upon the quality of the water, the water in the boiler is kept clean, no scale will be formed or dirt accumulated, and that any scale that may already be formed on the sheets will gradually disappear. The device is patented.

C. J. H. Woodbury, well known to our readers, has had the honorary degree of Master of Arts conferred upon him by Tufts College.

MANUFACTURES.

New Castle (Del.) County Levy Court will build a $3,000 iron bridge across Blackbird Creek.

A company has been chartered for the purpose of erecting a cotton-mill in Talladega, Ala.

A lot of new machinery is being added to the Anthracite Brass Works at Tamaqua, Pa.

The Novelty Machine Works have been incorporated to do business at Charleston, W. Va.

Work was begun Monday on the $500,000 plant of the Whitman-Barnes Co., at West Pullman, Ill.

A three-story addition is being erected to the factory of Wade & Davis at North Attleboro, Mass.

The Andrews Wire Works at Rockford, Ill., are erecting new buildings so as to double their capacity.

The Weber Brothers Metal Works, of Chicago, Ill., have been organized by Chas. F. and Wm. J. Weber.

The Eagle Flour-mills Company, at Petersburg, Ill, has been incorporated, with a capital of $20,000.

A Philadelphia syndicate is negotiating for the purchase of the Chess Bros.' iron works, Pittsburgh, Pa.

The L. E. & D. Railroad Company has commenced the erection of its new machine and repair shop at Windsor, Mich.

The Northwestern Car Company, of Detroit, Mich., has broken ground for a 100x380 foot building at Oshkosh, Wis.

At Bowie, Tex., C. H. Thompson and George L. Casner have organized a stock company for the erection of a cotton-mill.

Charles H. Schieren & Co., of Brooklyn, N. Y., will establish in Bristol, Tenn., a tannery of 10,000 hides capacity per annum.

The Berlin Iron Bridge Co., of East Berlin, Conn., are putting up a new foundry for the Watts-Campbell Co., at Newark, N. J.

Stearns, Rogers & Co. are making many extensive improvements about their foundry and machine shops at Pueblo, Col.

At St. Francis, Ark, S. D. Kimball and others have formed the Bradford Manufacturing Co., with a capital stock of $5,000.

Work has been commenced on the new $500,000 plant which the Whitman-Barnes Company, of West Pullman, Ill., is erecting.

At Lake Worth, Fla., a $50,000 stock company has been organized to erect a canning factory. Geo. R. Davis, of Chicago, is president.

The Toledo Bridge Co. is constructing another addition to its plant in East Toledo. The new structure is 90 feet wide by 250 feet long.

The Piqua Boiler Company has been organized at Piqua, O., with $50,000 capital stock, to build steam boilers and tanks and similar work.

The Princess Anne (Md.) Manufacturing Co. has formed with a capital stock of $30,000, for the purpose of establishing a basket and crate factory.

The Wheeling (W. Va.) Steel Works will make extensive improvements and additions to its plant, increasing its capacity more than 100 tons daily.

The Keystone Butter Co, of Cincinnati, O., with a capital stock of $20,000, was incorporated this week by Lytle J. Hunter and Joseph H. Hunter.

The Crescent Foundry and Construction Co., recently organized at Pittsburgh, has purchased the plant of the Crescent Foundry Co., Allegheny, Pa.

A condensing plant to supply the mills with water from Mount Hope Bay will be constructed at the American Linen Factory at Fall River, Mass.

E. M. Coglin and D. M. Coglin have incorporated the Harrisburg (Tex.) Handle Co., to manufacture woodenware, with capital stock placed at $20,000.

The new Lambeth Pope Manufactory at New Bedford, Mass, will include an 860x39-foot and two story building and a 48x28-foot boiler and engine house.

Articles of incorporation have been filed by the J. J. Costello Hardware Company, of Duluth, Minn. The capital stock of the company is $100,000.

Hoopes & Townsend, in Philadelphia, are building a new bolt shop 46x202 feet, a blacksmith shop 59x200 feet, and a two-story machine shop 40x100 feet in size.

The Jewett Car Co., Ltd., of Jewett, O., has under construction a frame building 50x250 feet, two stories high, for the manufacture of street and railroad cars.

The Erie Engine Works, of Erie, Pa., was recently chartered by F. F. Cleveland and others for the manufacture and selling of engines, boilers, tanks and machinery.

The Central Indiana Car Works has been recently formed at Chicago with a capital stock of $500,000. The incorporators are A. C. Miller, N. D. Pontius and J. D. McKittrick.

The building of the National Car Spring Co., of Newark, N. J., has been destroyed by fire. The loss is placed at $50,000, and is covered by insurance. The works will be rebuilt.

The Southside Foundry and Machine Company, of Charleston, W. Va., is preparing to greatly enlarge the capacity of its plant. It will erect new buildings and add new machinery.

The work of constructing the new foundry in connection with the Edgar Thompson Steel Works at Braddock is progressing rapidly. Two of the main buildings are now under roof.

Quigley & Co., of Birmingham, Ala., have shut down their foundry in order to make extensive additions, which have become imperative owing to the rapid increase in their business.

The Hartman Manufacturing Company, of New York, has been formed to manufacture gas and electric fixtures. Capital, $25,000; and directors: E. R. Vollman and Julia Hartman.

At New Bedford, Mass., ground was broken for the foundation of Hathaway, Soule & Harrington's new chimney. It will be 75 feet high, 10 feet square at the bottom and 5 feet square at the top.

The Pepsin Syrup Co. has been organized at Monticello, Ill., to manufacture pepsin; capital stock, $500,000; incorporators, C. H. Ridgley, H. H. Crea, H. P. Harris, W. S. Ridgley, W. E. Rodgers.

The Speer Hardware Company, of Fort Smith, Tex., has been incorporated with a capital of $60,000 by D. Speer, C. E. Speer and R. E. Vick. The purpose is the manufacture of hardware specialties.

In connection with the rebuilding of the burned portions of its works, the King Bridge Company, of Cleveland, will erect an entirely new riveting department, which is expected to be most complete.

The Kelley Iron Company, of New York, will probably erect a $400,000 plant at Hamilton, Mich., an agreement having practically been reached by which the city gives them a valuable site and $40,000 in cash.

Benjamin Crane, of New York City, is about to start up his new pearl button manufactory at Hicksville, N. Y. Eighty hands will be employed at the outset, the number to be increased as rapidly as necessary.

The Henry L. Reutebler Manufacturing Co. has been organized at Belleville, Ill., to manufacture paper bag holders; capital stock, $25,000; incorporators, Otto M. Stiebl, Louis K. Morgan, Henry L. Reutebler.

The Leisenring Manufacturing Company, of Scranton, Pa., has been incorporated with the capital stock placed at $12,000 for the manufacture of iron, steel, etc. W. W. Watson, of Erie, Pa., is one of the incorporators.

The Wheeling Mold and Foundry Company, of Wheeling, W. Va., has been chartered to manufacture and deal in molds, castings, structural work, etc. Charles E. Blue, James B. Moore and Arthur Hubbard are among those interested.

At Savannah, Ga., the Sternberg Jewelry Co. has been formed with a capital stock of $25,000, for the purpose of manufacturing jewelry. The incorporators are: J. J. Cohn and S. Lindenborn, of New York City, and M. Sternberg, of Savannah.

The Wood Cigarette Machine Co. has been chartered at Richmond, Va., to have a capital stock of not less than $25,000 nor more than $50,000. Wm. P. De Saussure is president; John R. West, vice-president, and Thomas B. Scott, secretary and treasurer.

Application for a charter for the National Railroad and Equipment Co., Atlanta, Ga., has been made by F. W. Miller and J. C. Bryan. The capital stock is to be $1,000,000, with privilege of increasing to $5,000,000. They propose to manufacture all kinds of railway equipment.

The Oswego (N. Y.) Tool Company and the Place Manufacturing Company, of Oswego, have consolidated under the corporate name of the Oswego Tool Company. The new company will continue the manufacture of machinists', boiler makers', plumbers' tools, wrenches, etc.

A certificate of the incorporation of the Hamilton Manufacturing Company was filed at the New Jersey County Clerk's office recently. David A. Pell, Helmas Romaine, Cornelius A. Cadmus, Joseph D. Roberts, Walter E. Sweitzer, George W. Byrom and George A. Bushe are the incorporators. The capital stock is $100,000, of which $10,000 has been paid in. The company will engage in the manufacture of carriages.

Mr. E. R. Richards, the New York agent for J. A. Fay and Egan Co., of Cincinnati, O., has lately secured several large orders for complete outfits for new factories, notable among which is the one for J. Curley, carriage manufacturer of Brooklyn, N. Y. The addition consists of band saws, circular saws, boring machines, planers, shapers, sand belts, rounding machines, emery wheel grinders, blowers, some special machines and several elevators, all of which are driven by electricity.

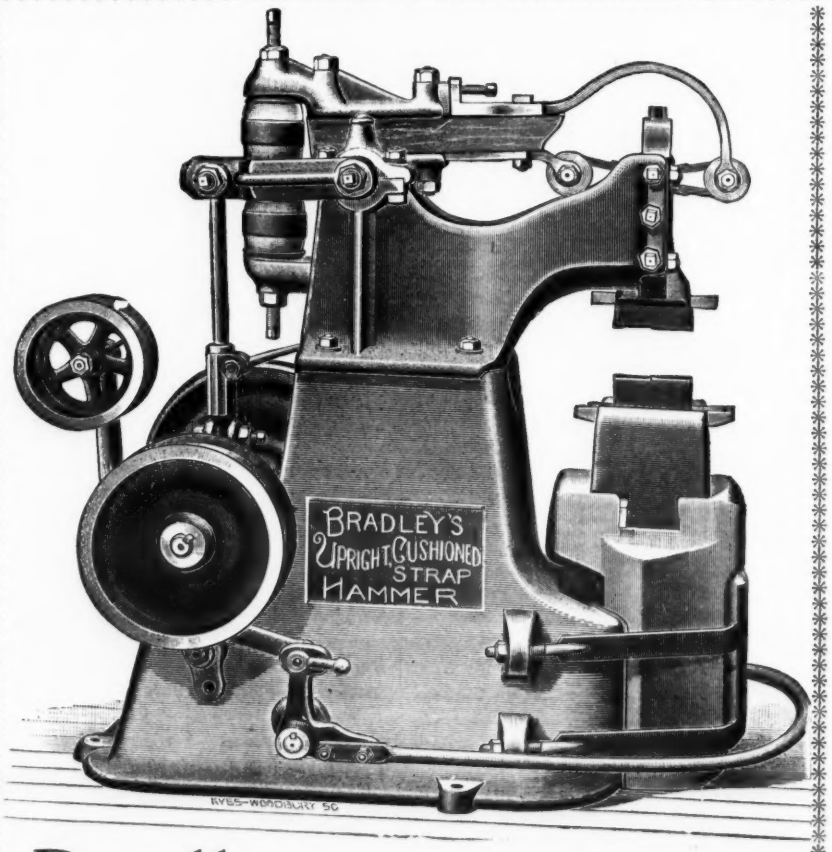
The Marine and Life Saving Fog Signal Company has been organized in Bangor, Me., with a capital of $500,000, for the purpose of manufacturing and selling marine and life saving fog signals, and to sell right and license to make and use such signals and inventions of W. R. Close. The officers of the company are as follows: President, C. A. Gibson; treasurer, A. J. Merrill; directors, C. A. Gibson; C. C. Prescott, W. B. Eaton, W. R. Close and A. J. Merrill.

Machinists' Supplies and Iron.

NEW YORK, June 24, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.75 to $14.50 for No. 1 Foundry; $12.50 to $13.50 for No. 2 and $11.75 to $12.50 for Gray Forge.

(*Continued on page* 12.)



Bradley Hammers.

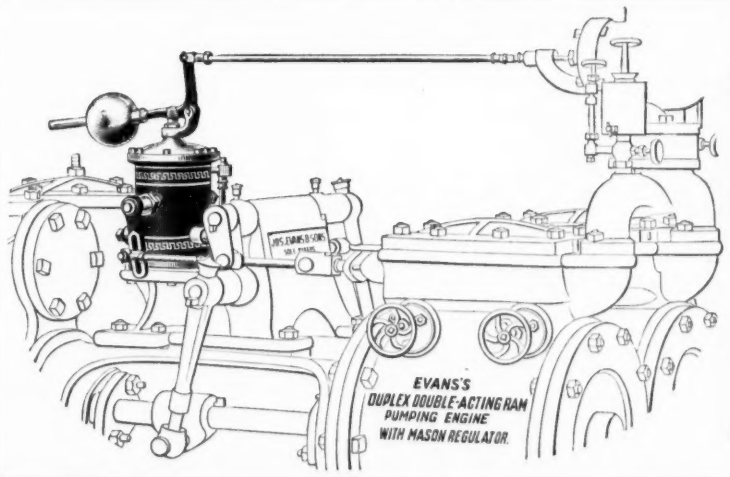
If you plate, draw, square, taper or weld iron and steel, you need a Bradley Hammer.

If you swage, collar, spindle, or do any manner of die work, a Bradley Hammer will soon pay for itself.

That the Bradley is the best Power Hammer in the market has never been questioned. Our circulars illustrate, describe, give sizes and prices.

BRANCHES: 14 Warren St., New York. 96-98 Sudbury St., Boston.

BRADLEY & COMPANY, Syracuse, N. Y.



Method of Applying

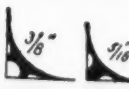
THE MASON PUMP GOVERNOR

Manufactured by

MASON REGULATOR CO., BOSTON, MASS.

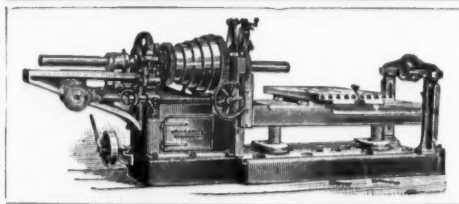
OUR NEW CATALOGUE
—OF—
TEXT BOOKS AND INDUSTRIAL WORKS
Will be sent Free by Mail to any one writing for it.
JOHN WILEY & SONS.
SCIENTIFIC PUBLISHERS, NEW YORK.

Ready Made Cut Gears.
Ready Made Cast Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
Gear Book, 15 cents.
Treatise on Gears, $1.00.
Gear Cutting Machines.
GEORGE B. GRANT,
Lexington, Mass.,
and 125 South 11th St.,
Philadelphia, Pa.



Flexible Metallic Fillet
For Pattern Makers. 8 Sizes.
H. WHITE, 44 N. 4th St. Phila. Pa.

Back Volumes of the
AMERICAN MACHINIST
for 1880, '82, '83, 84, '85, '87, '88, '89, '90, '91 and '92.
A FEW MAY STILL BE HAD.
Address AMERICAN MACHINIST, 203 Broadway, N. Y.



BETTS MACHINE CO.,
WILMINGTON, DEL.
MACHINE TOOL BUILDERS.
IMPROVED PATTERNS! LATE DESIGNS!
Chicago Office: 14 South Canal St.

ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.

Antimony—The market is steady. We quote L. X., 10¼c. to 10¾c.; Cookson's, 10½c. to 10¾c.; Hallett's, 9¾c. to 9 95c.. and U. S. French Star. 10¼c

Copper—The market continues dull; some business is reported in Lake Copper at 10¾c., and deliveries for the balance of the year can be bought at the same price. Casting Copper is held at 10c. to 10¼c.

Lead—The market continues to decline, 3.50c. will buy. The demand is light.

Lard Oil—Prime City is quoted at 75c. to 76c.

Spelter—The market is about steady at 4.22½c. to 4.25c., but more or less nominal, owing to the absence of demand.

Tin—The market is steady. Sales of spot delivery were at 20c., June at 20.05c , and July at 20.10c. There is a disposition of asking better rates.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Mechanical draftsman, exp'd, good designer, shop practice, wants position. L. C , AM. MACH.

Draftsman experienced on machine tools, desires position. C., Box 47, AMERICAN MACHINIST.

Wanted—Situation as foreman blacksmith; thor. comp't; best of refs. given. B. K., AM. MACHINIST.

Wanted—Pos. as sup't of mach. works, by a prac. mach. & draftsman; age 32. "Energetic," AM. MACH.

Wanted—Position as foreman boiler maker; 12 yrs'. exp.; ref. A1. A. M P., Box 92, Roanoke, Va.

Wanted—Foreman blacksmith on machine tool work; must be well posted on piece-work. Address Box 4, AMERICAN MACHINIST.

Position wanted by an experienced foundryman as manager, superintendent or general foreman; A1 ref. furnished. Address Box 13, AM. MACHINIST.

Draftsman wishes position, 2 years' exp. in general engine and machine work; best refs. from last employer. Address Box 15, AM. MACHINIST.

Draftsman, graduated M. E., several years' exp. on steam eng. & mach'y in gen., is a good mechanical designer, wishes engagem't. Box 16 AM. MACH.

Pract'l & progressive machinist, aged 30, well up interchangeable work, wishes position as foreman. Address for particulars. Box 18, AM. MACHINIST.

Draftsman desires position; age 25; experience, power cranes, engines, pumps and special machinery. Address Box 19, AMERICAN MACHINIST.

A mech. draftsman wants a steady sit.; has college education and several years' exp. as draftsman; no object'n to the country. A. H., AM. MACH.

Wanted—Foreman blacksmith. Shop has 26 fires, 2 large steam hammers. Must be first class man. State refs., and wages expected, Bucyrus Steam Shovel and Dredge Co., South Milwaukee, Wis.

Shop agents for Carr's surface gauge and key rule clamps; liberal discounts; send for circulars; 2,000 gauges sold in past six months The Hoggson & Pettis Mfg. Co., New Haven, Conn.

Wanted—A general foreman; must be familiar with the rapid and accurate production of interchangeable metal parts; experienced in bicycle mfg. preferred. The Black Mfg. Co., Erie, Pa.

Mechanical engineer, 21 years' experience is open for engagement; experienced in engines, mining mach'y, pulp making, electric light plants, plans, estimates and superintends erection; a thorough practical machine designer. Box 17, AM. MACH.

Wanted—Position by a first-class tool and gauge maker well up in modern practices; best references; has filled the position as foreman; age 33. Address Box 12, AMERICAN MACHINIST.

Wanted—By young man, first-class pattern maker and draftsman with drawing room, technical and practical experience, position with firm appreciating nice work. Box 14, AM. MACHINIST.

Wanted—Position as foreman of foundry; well up in all foundry practice; have had large experience in the handling of men; strictly temperate; the best of references. Address Box 9, AMERICAN MACHINIST.

Wanted, immediately—Thoroughly competent foundry foreman, one who is accustomed to and understands thor. the making of light and heavy mach's and eng. cast's. Address, with refs., exp. & salary, the Jenckes Machine Co., Sherbrooke, Que.

Wanted—As instructor, an M. E. graduate with 3 yrs' exp. in the designing of machinery and in testing of steam plants; must be able to begin work Sept. 13. Address applicarion and references to Prof. Mech'l Eng'g, 357 Market st., Bethlehem, Pa., stating past experience and salary expected.

Wanted--A young man experienced in expert work on machinery and machine tools; a practical machinist & tool maker with experience in drafting & designing machine tools and special machines is open for engagement; a Christian man with past record open for inspection. At present occupy pos of supt. in mfg. industry; can furnish good refs. as to skill, habits & industry; any comp'y desiring my services please address F., AM. MACH.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Punch & Drop Presses. Am. Tool W'ks., Clev., O.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz. Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

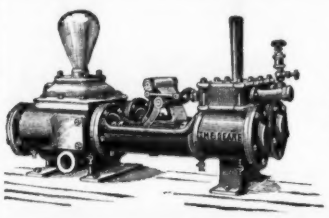
For Sale—A machine shop fully equipped; invoice about $2,500, can be purchased at a bargain if sale is made within 30 days. H F. Quickel, Harrisburg, Pa.

Wanted—Partner in an iron foundry in St. Louis, Mo , with $1,000 to $5,000. Write J. McCash, 619 Harris Ave., St. Louis, Mo.

For Sale—One-half interest in a small well paying machine business can be bought reasonable; good chance for a bright, active machinist. Address A., AMERICAN MACHINIST.

We will pay 50 cents each for copies of the AMERICAN MACHINIST of December 4, 1886 issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Machine Shop and Foundry for Sale—Located in a fine village in Central New York. At present employing 8 men building medium grade work. A rare opportunity for 1 or 2 practical men to engage in an established and growing business. If the whole is not sold soon, I will sell an interest to a practical man who can furnish references as to integrity & ability. A full opportunity to investigate offered any one meaning business. Box 150, AM. MACH.



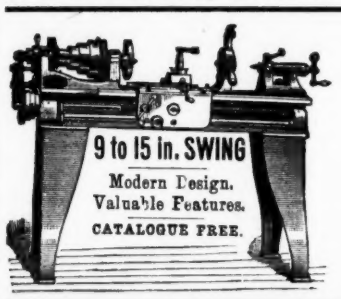
THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO'S
PITTSBURG, CHICAGO, NEW YORK.
STEEL FOR Lathe and Planer TOOLS, Cold Chisels, Punches & Dies, Milling Cutters, Molding Bits, &c.
SHEET STEEL, POLISHED Drill Rods, SPRING STEEL, Machinery Steel, COILED SPRINGS, Steel Forgings, ETC.

A NEW SCREW PLATE.

THE HANDIEST PLATE MADE.
THE FULL MOUNTED LIGHTNING.
These Plates have a stock with each die. The dies are our celebrated Adjustable **Lightning** Dies. Each Stock is of correct length and weight to suit size of die. Several sizes of dies may be in use out of same set at same time. SEND FOR CATALOGUE. Made by
WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.

"R. MUSHET'S SPECIAL STEEL"
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
SOLE REPRESENTATIVES IN THE UNITED STATES,
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St. NEW YORK: 143 Liberty St.



SEBASTIAN LATHE CO.
117 & 119 Culvert St., Cincinnati, O.
Manufacturers of Foot and Power
ENGINE AND SPEED LATHES,
For General Machine and Jobbing Shop, Electrical and Experimental Work.
DEALERS IN MACHINISTS' TOOLS AND SUPPLIES.

JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
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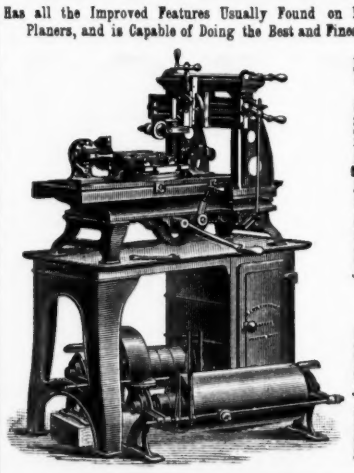
WM. JESSOP & SONS, LD.
Established a century ago.

POWER OR HAND PLANER,
FOR MODEL MAKERS, EXPERIMENTAL WORK, &c.
Has all the Improved Features Usually Found on High Grade Planers, and is Capable of Doing the Best and Finest Work.



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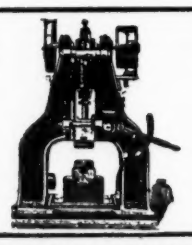
184 Washington Street, Boston, Mass.

HACKNEY HAMMERS
Meet all requirements more fully and satisfactorily than any other of its competitors.
INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.
WRITE FOR CATALOGUE TO
THE HACKNEY HAMMER CO.
20 Johnson St., CLEVELAND, O.



MACHINE TOOLS
NEW AND SECOND-HAND.

ENGINE LATHES.

13 in. x 6 ft.,	Complete. Cpd. Rest and Cross Feed	Improved style
14 in x 6 ft.,	do	Prentice, Her[illegible] & Fitchburg
16 in. x 6 ft ,	do	Hendey Fitchburg and Prentice
16 in. x 6 ft.	do	Bridgeport Mach Tool Works. [illegible] order
16 in. x 8 ft.,	Improved style. Cpd. Rest and Cross Feed.	
18 in. x 5½ ft.	Complete, with Hollow Spin., 1¾ and Ck.	1 order
18 in. x 8 ft.	Improved style. Complete.	
20 in. x 8–10 ft.,	do	Cpd. Rest and Cross Feed.
22 in. x 10–12 ft.,	do	Improved style. Ex. heavy.
24 in. x 12–14 ft.,	do	do. do
28 in. x 16 ft.,	do	do do
30 in. x 18 ft.,	do	Old style. Fair order Cheap.
96 in. x 16 ft.,	Triple geared 84 in Face Plate.	Good order.

PLANERS.

22 in. x 5 ft.	Complete, with Chuck. Putnam.	A1 order.
24 in. x 6 ft.,	do	Extra heavy.
28 in. x 6 ft.,	do	New Improved style
28 in x 6 ft.,	do	Putnam. Good order.
30 in x 10 ft.,	do	Good order. Low Price.
36 in. x 12 ft.	do	Modern style. Ex. heavy. A1 order.
80 in. wide	10 ft. long, with 2 Heads.	Extra weight and power. Powell Planer Co. "New latest pattern."

SHAPERS.

8 in. Stroke	Crank.	Good order.	Gould
9 in.	do	do Extra heavy.	Hewes & Phillips
13 in.	do	do Good order.	
14 in.	do	do Trav. Head. Improved style.	Fitchburg
15 in.	do	do "New Improved Style."	
22–26 in.	do	Triple Geared. Improved.	

MISCELLANEOUS.

Radial Drills, 3, 4, 5 and 6 ft. Arms. Improved.
Upright Drills, 20 21, 25 and 32 ins. Prentice.
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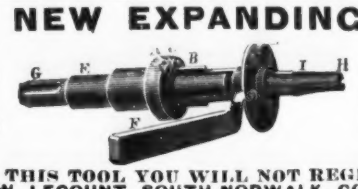

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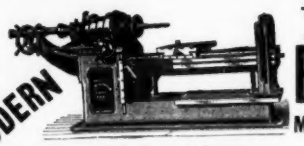
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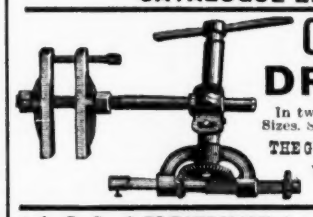

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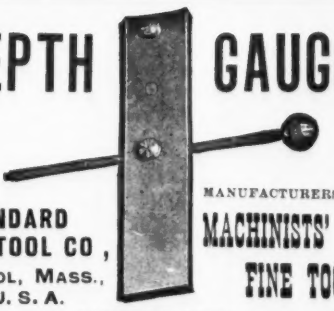
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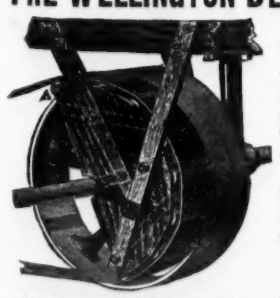
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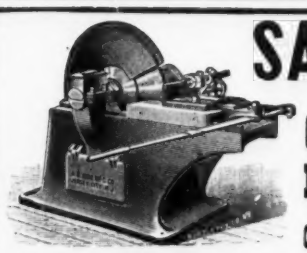
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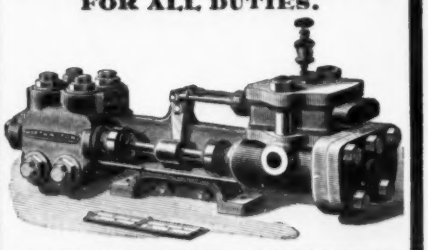
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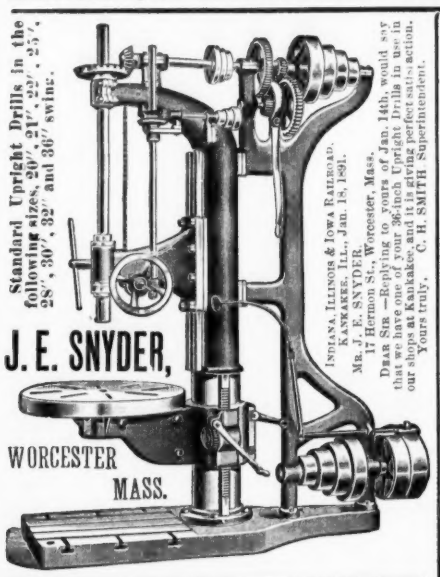

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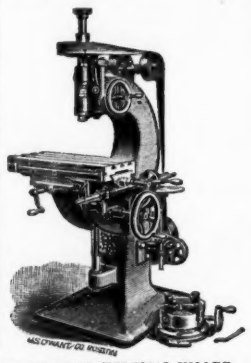

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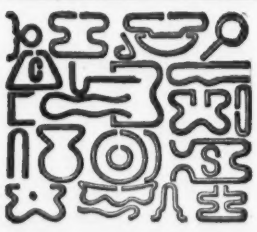

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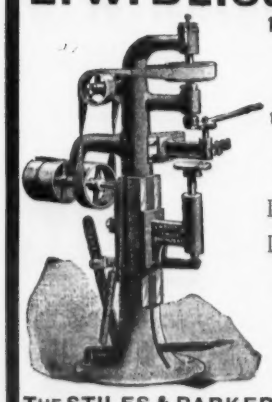

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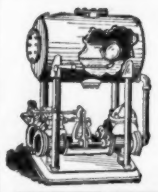

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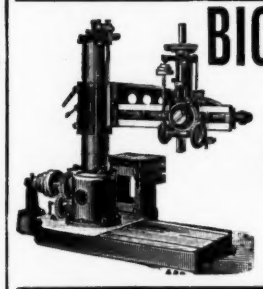

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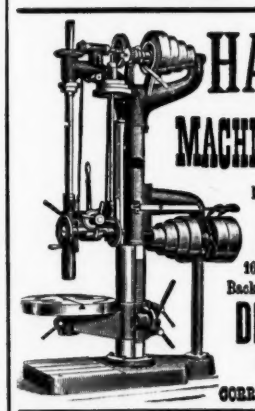

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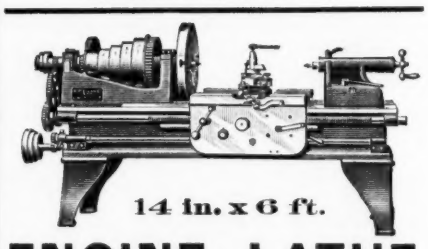

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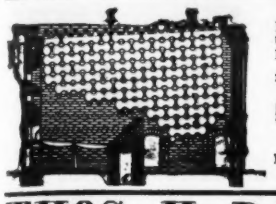

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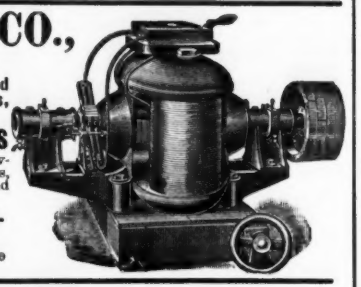

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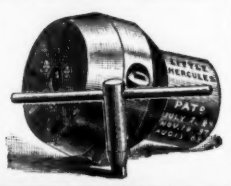

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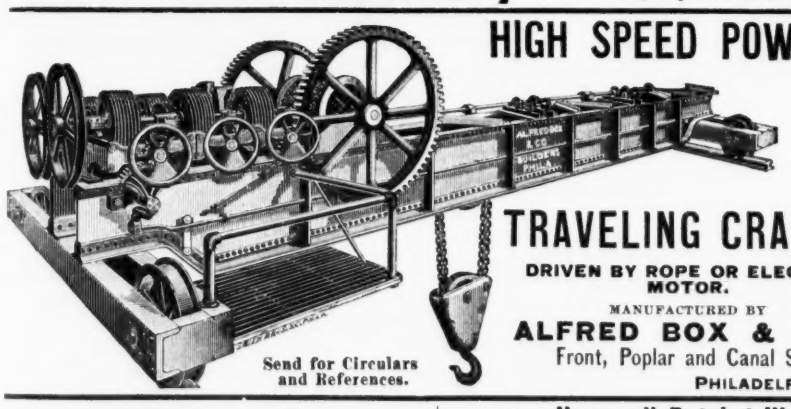

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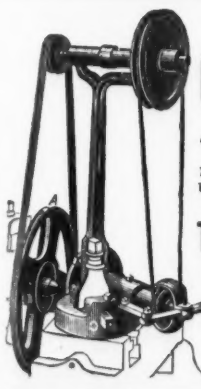

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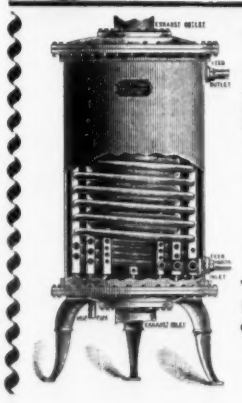

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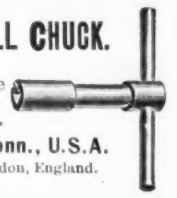

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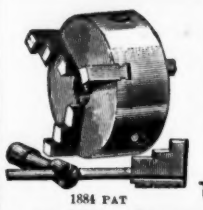

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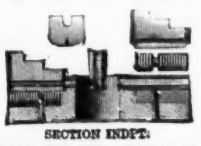

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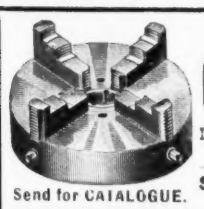

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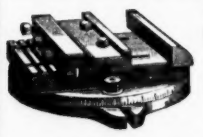

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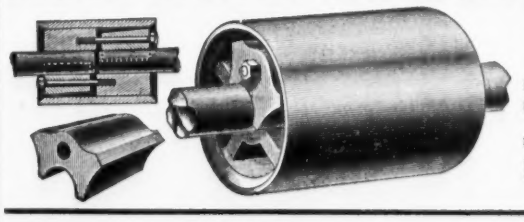

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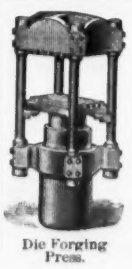

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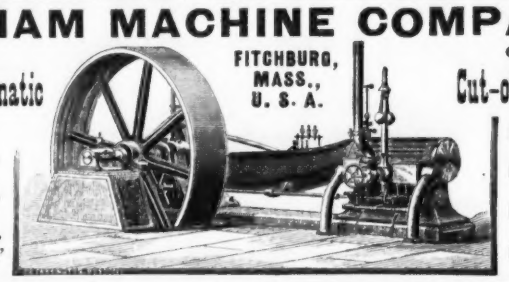

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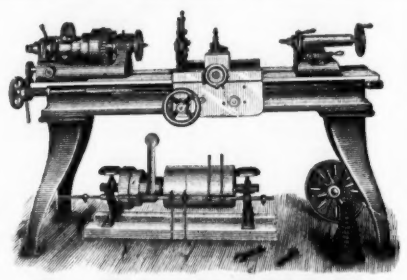

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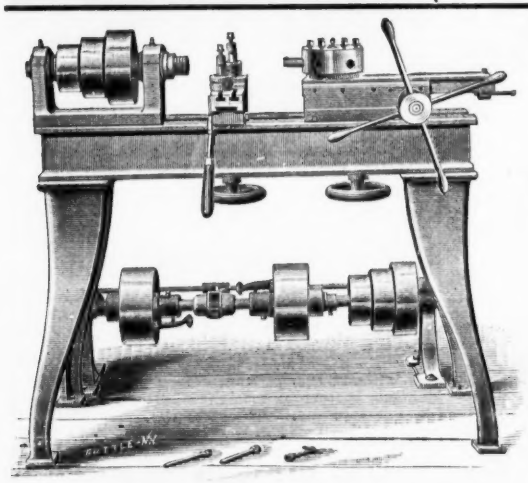

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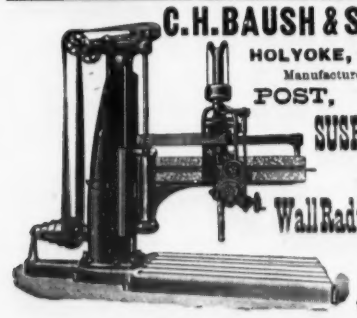

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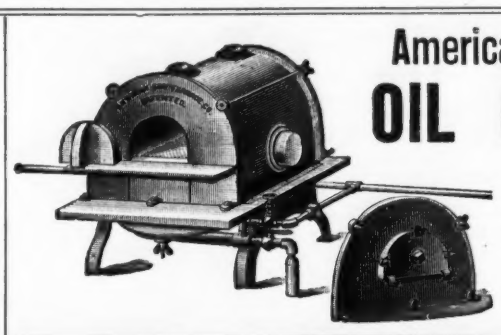

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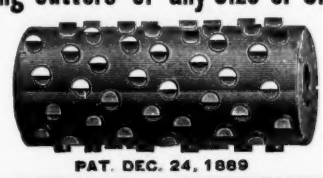

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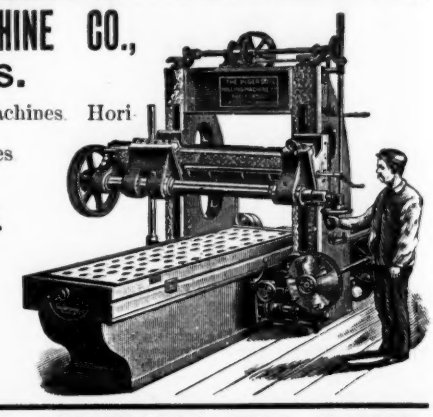

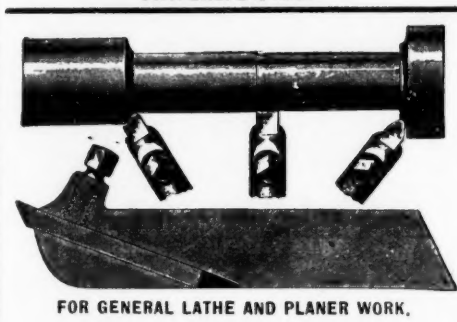

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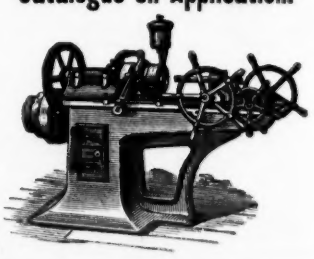

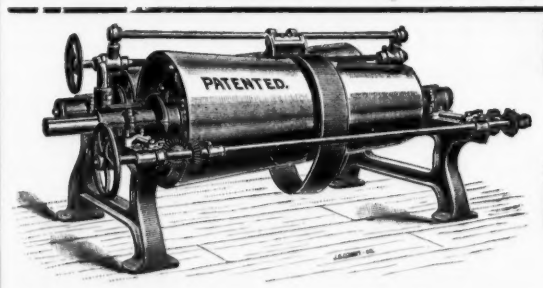

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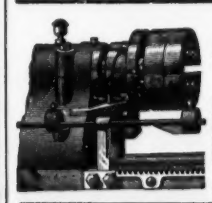

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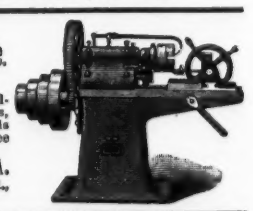

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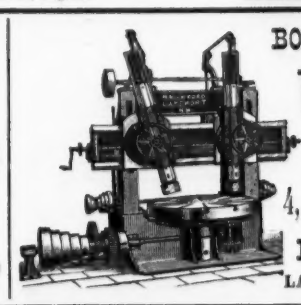

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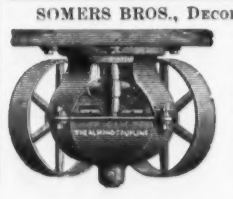

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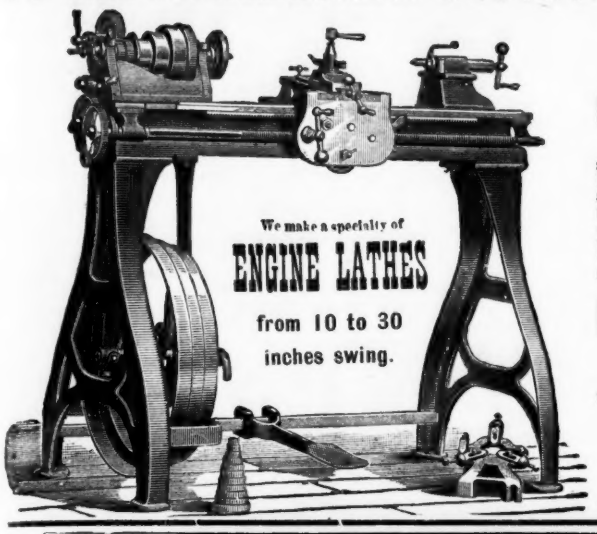

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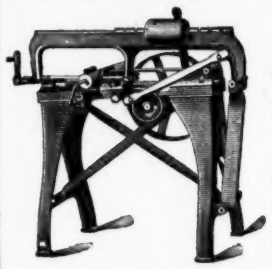

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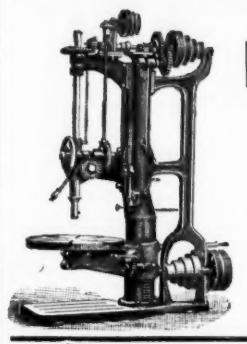

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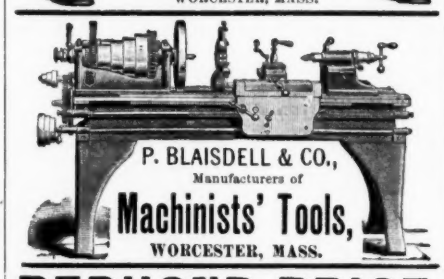

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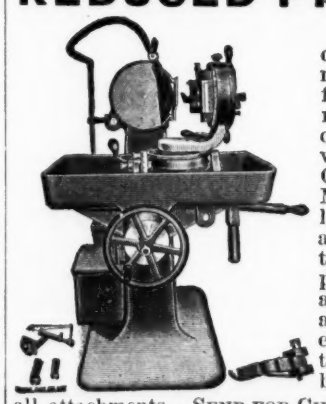

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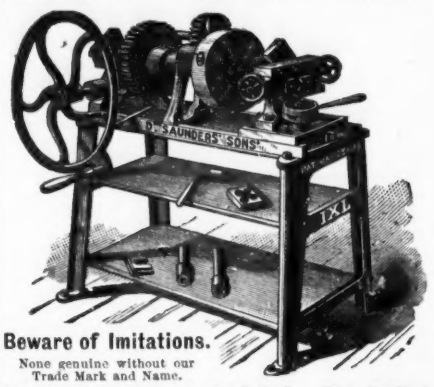

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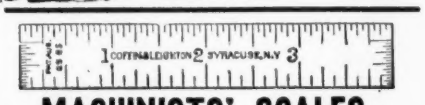

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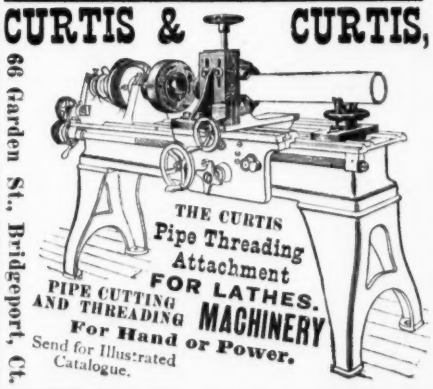

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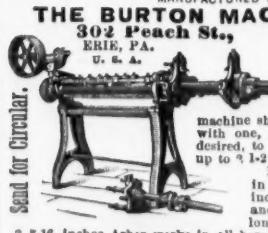

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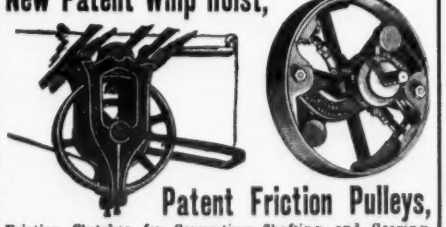

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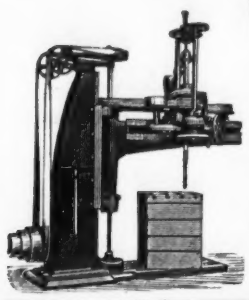

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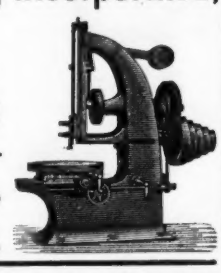

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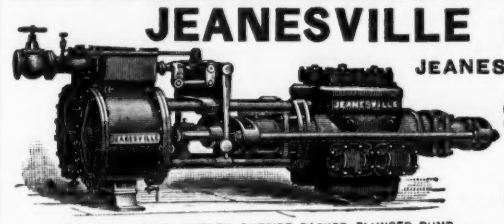

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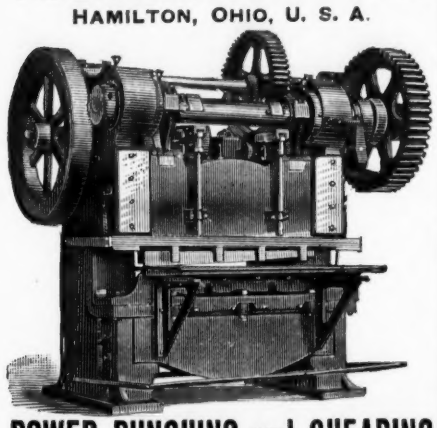

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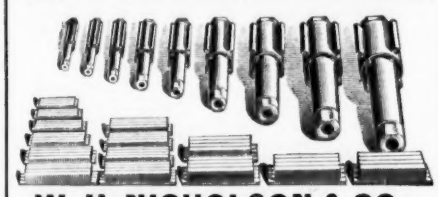

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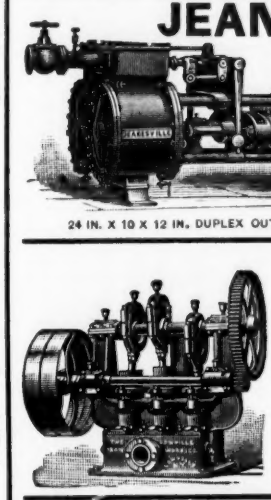

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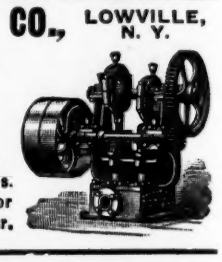

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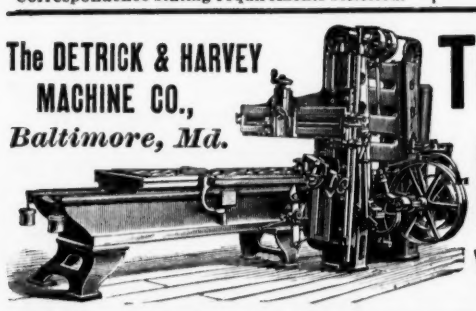

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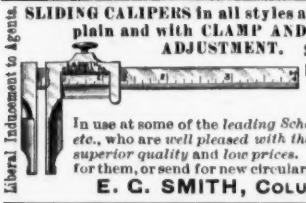

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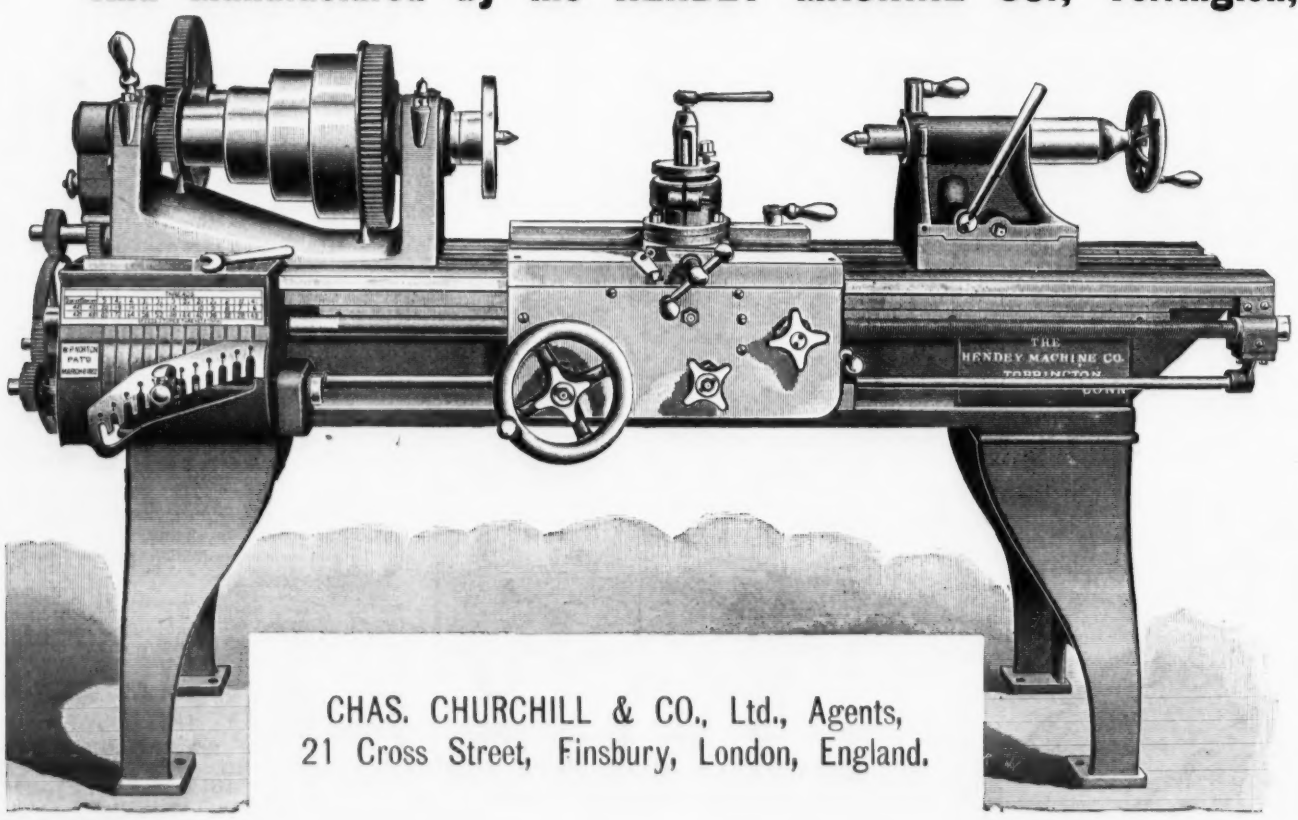

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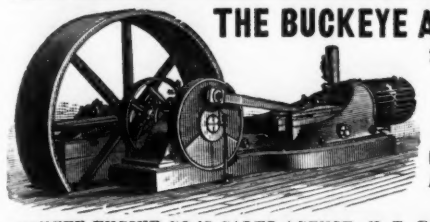

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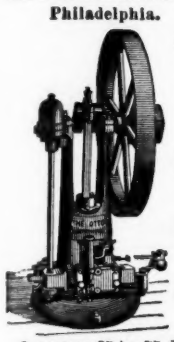

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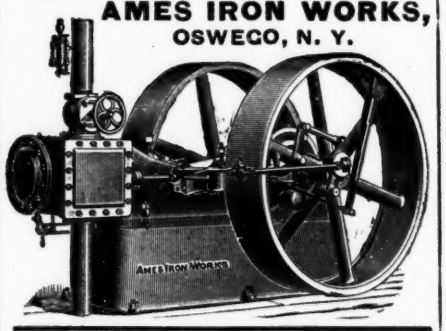

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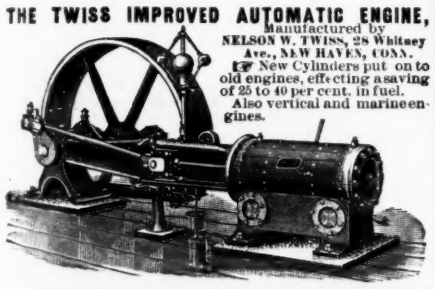

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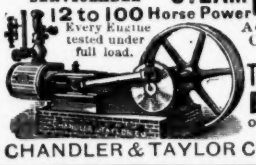

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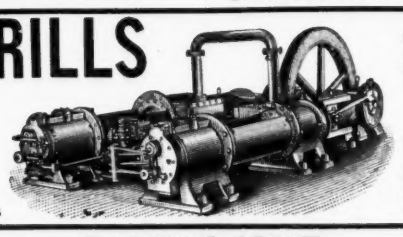

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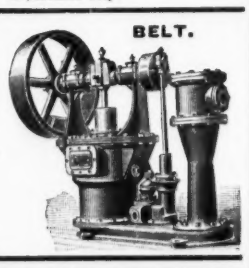

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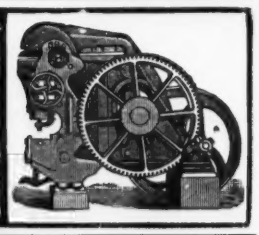

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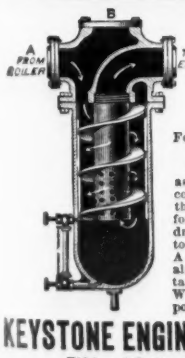

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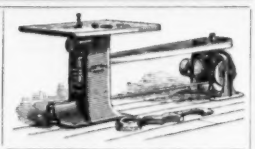

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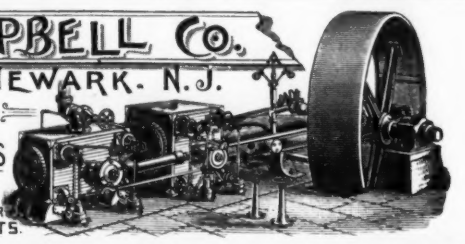

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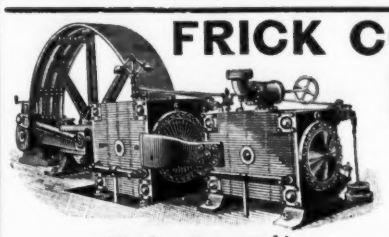

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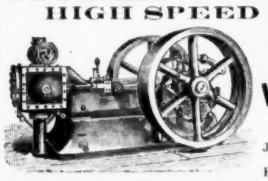

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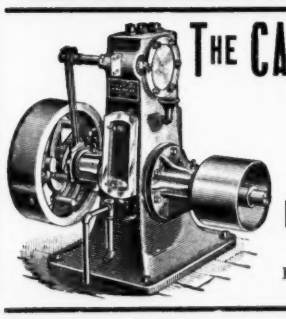

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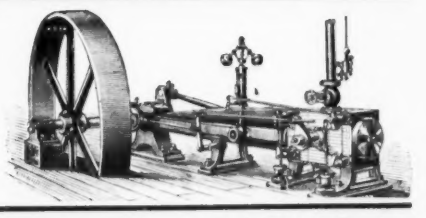

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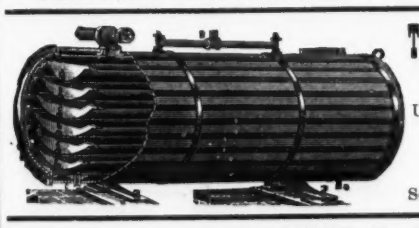

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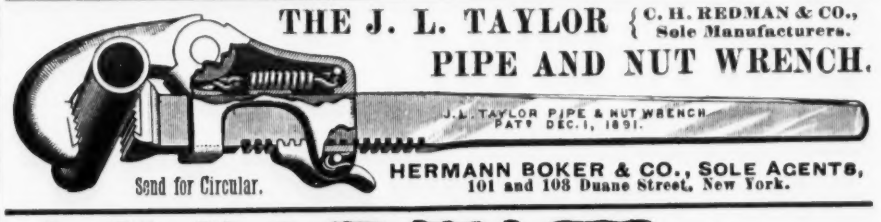

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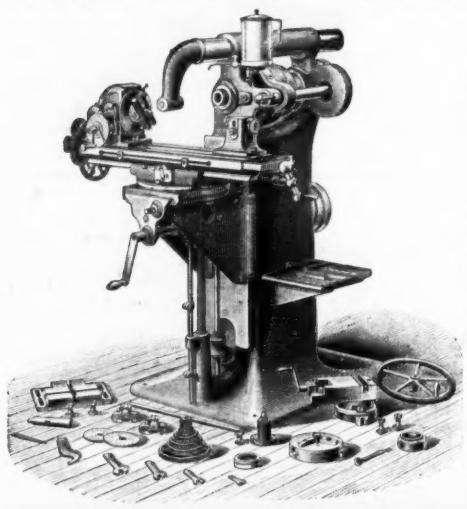

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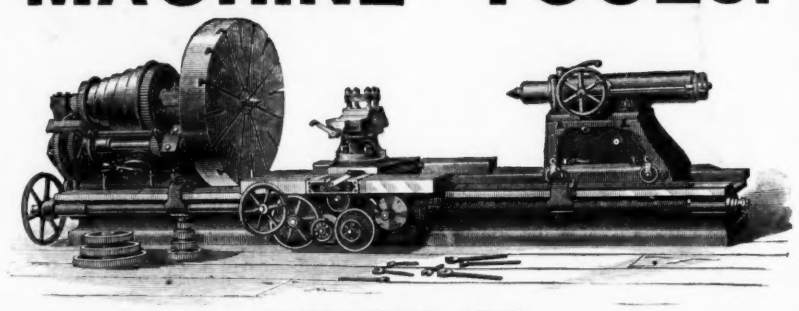

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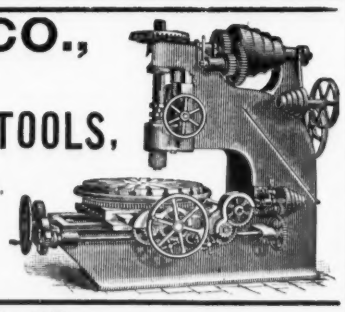

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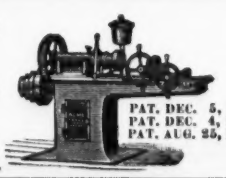

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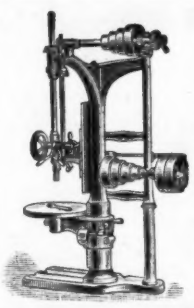

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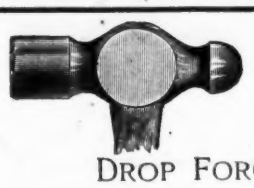

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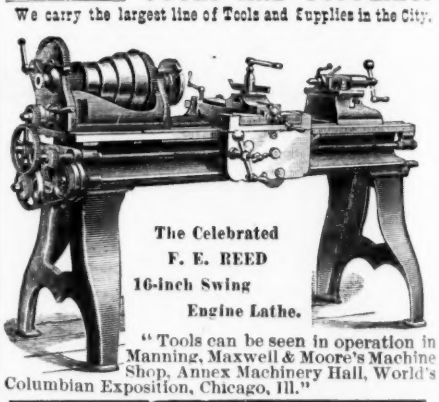

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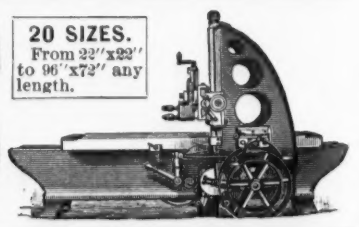

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